

A review of the *Cochylimorpha perpusana* (Guenée, 1845) species group (Lepidoptera, Tortricidae) in Europe, with the description of a new species from the Southern Carpathians (Romania)

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Abstract. European species of the *Cochylimorpha perpusana* (Guenée, 1845) species group are revised. Four species are recognized, all closely related to *C. perpusana* (Guenée, 1845) with which they have previously been confused. Based on morphological differences and DNA barcode data, *C. callosana* (Herrich-Schäffer, 1856), **sp. rev.** and *C. dorsimaculana* (Preissecker, 1908), **sp. rev.**, are re-instated to their original species rank. Inconsistencies in their taxonomy leading to their synonymy are shown and corrected. *Cochylimorpha bucegi* Z. Kovács, S. Kovács & P. Buchner, **sp. nov.** is described from the subalpine meadows of the Bucegi and Făgăraș Mountains (Southern Carpathians, Romania), and the other three species are redescribed. Adults and genitalia of both sexes of all four, and the habitat of three taxa are figured. The geographic distribution of each species is re-evaluated based on the examined material and a critical analysis of the literature. Literature data for which no material could be found for examination are treated as doubtful and in need of confirmation. *Cochylimorpha perpusana* is widely distributed in mountain areas of Europe (Alps, Carpathians and Pirin Mountains), *C. callosana* is widespread only in the north-western Balkan Peninsula and north-eastern Italy, and local in eastern France, Corsica and Hungary, the other two seem to be endemics, *C. dorsimaculana* to Wachau and Retz in Lower Austria and *C. bucegi* **sp. nov.** to the Southern Carpathians in Romania. *Cochylimorpha perpusana* is recorded for the first time from Bulgaria; the first confirmed records of *C. callosana* from Slovenia and Hungary are given; and in the north-eastern Italian fauna *C. callosana* replaces *C. perpusana*. Records of *C. perpusana* from Ukraine, the Czech Republic, Slovenia, and north-western Italy require confirmation.

Introduction

Within the European Cochylini, comprising 197 species, the most species-rich genera are *Aethes* Billberg, 1820 with 46, *Phtheochroa* Stephens, 1829 with 41 and *Cochylimorpha* Razowski, 1959 with 39 taxa (Lepiforum e.V. 2006–2024, accessed on 5 March 2024). In the informal *Cochylimorpha perpusana* (Guenée, 1845) species group three taxa have been described from Europe: *Argyrolepis perpusana* Guenée, 1845, *Cochylis callosana* Herrich-Schäffer, 1856, and *Euxanthia dorsimaculana* Preissecker, 1908, all based on external morphology (Guenée 1845: 302; Herrich-Schäffer 1856: 157; Preissecker 1908: 70–72). In his revision of the Palearctic Cochylini, Razowski (1970: 38–39, 162)

synonymized the latter two with *C. perfusana*, and assigned them to the genus *Stenodes* Guenée, 1845 based on the similarity of the male genitalia. This taxonomic status has been generally accepted for more than 50 years, the only change was the new combination of the species with *Cochylimorpha* Razowski, 1959 (Razowski 1991: 105), as the genus name *Stenodes* proved to be preoccupied.

The suspicion that *C. perfusana* might be more than a single species arose more than 20 years ago, when the first two authors revised the Romanian Cochylini. They observed that material from two populations differed. Owing to the similar male genitalia and the lack of a female from one of the populations, they treated them as the two forms of *C. perfusana*, the typical form and f. *callosana*, following the species concept accepted at the time (Kovács and Kovács 2005: 87–88). When comparing data from old literature sources (Herrich-Schäffer 1851, 1856; Kennel 1913) to those in the monograph of the Palaearctic Cochylini (Razowski 1970), they discovered inconsistencies in the taxonomy which, together with the similarity of the male genitalia, probably led to the synonymy of all known taxa in this species group (Razowski 1970: 38–39, 162). They also noticed that in the earlier and subsequent works of Razowski (1970, 1987, 2001, 2002, 2009) two different genitalia of both sexes were figured under the name *C. perfusana*. Later, when the female genitalia of both Romanian populations became available for study, they realised that those from the Eastern Carpathians are similar to the specimens originating from Austria and the genitalia figured by Razowski (1970), but the genitalia of the other population, from the Southern Carpathians, differ from all genitalia figured by Razowski (1970, 1987, 2001, 2002, 2009). They concluded that in Europe there may be at least three different species. In the meantime, the last two authors of the present study observed that the material in their collections originating from different regions of Europe was heterogeneous, and also suspected the existence of more species. Type specimens of the available names were examined, and material collected from the type localities of *C. perfusana* and its synonyms and other regions of Europe were examined and barcoded. The differences in the external morphology and the genitalia of both sexes, combined with the results of the molecular studies, confirmed the hypothesis of a species group and revealed the existence of four related taxa in the European fauna. We describe a new species and compare it with the three previously named species.

Material and methods

A total of 157 specimens were examined from four major mountain ranges of Europe: the Austrian, Slovenian, Italian and French Alps; the Romanian Carpathians; the Pirin Mountains in Bulgaria; and the Velebit Mountains and its neighbouring low-mountain habitats in Croatia, Slovenia and Italy. The examined material was dried, pinned and partly set. The terminology of wing pattern and genitalia follows Razowski (1970, 2002), except that of the cornuti, which follows Anzaldo *et al.* (2014), and the costal roll (Pérez Santa-Rita *et al.* 2022). Photos were taken with a Canon EOS 5D Mark III camera, adults with a Canon lens MP-E 65, using ring flash and a magnification of 2:1, specimen details with 4:1 magnification, and genitalia with a microscope (Wild Heerbrugg) using a 10× objective and a 2.5× ocular lens. Images were stacked using Helicon Focus 4.80 software. Genitalia preparations followed standard techniques (Robinson 1976). Male preparations were stained with mercurochrome and females with chlorazol black, which gives a better result than using the same stain for both sexes. Samples from all major collecting areas were studied to assess possible geographical variation. Additional specimens were also examined from the different localities to detect potential intraspecific variability.

DNA samples from 19 specimens of the *C. perfusana* species group were processed at the Canadian Centre for DNA Barcoding (CCDB, Biodiversity Institute of Ontario, University of Guelph) to obtain DNA barcodes (658 base-pair long segments of the 5' terminus of mitochondrial cytochrome c oxidase I gene) following the standard protocol (whole barcode region sequenced at once, 3 samples) (deWaard et al. 2008), degraded material protocol (barcode region split into 2 fragments which were sequenced separately, eight samples) (Wilson 2012) and next-generation sequencing protocol (barcode region split into six short fragments which were sequenced separately, 8 samples) (Prosser et al. 2016). These resulted in seven full length sequences (658 bp), and four shorter sequences (one of 638 bp, one of 550 bp, two of 145 bp); eight samples failed. Two full length sequences of *Cochylimorpha jucundana* (Treitschke, 1835) are used as the outgroup. The sequences were submitted to GenBank, where further details including complete voucher data and images can be accessed through the public dataset DS-DEEUR398 (http://www.boldsystems.org/index.php/Public_SearchTerms?query=DS-DEEUR398; <https://dx.doi.org/10.5883/DS-DEEUR398>) (BOLD; Ratnasingham and Hebert 2007). Degrees of intra- and interspecific variation of DNA barcode fragments were calculated under the Kimura 2 parameter model of nucleotide substitution using analytical tools of BOLD systems v. 4.0. (<http://www.boldsystems.org>). A neighbour-joining tree was constructed using MEGA6 (Tamura et al. 2013) under the K2P model for nucleotide substitutions.

Photographs of the habitats, immature stages and host-plants in nature were taken using Canon EOS 10D and 50D digital cameras and a Huawei Nova 5T mobilephone.

Institutional abbreviations

MfN–Museum für Naturkunde, Berlin, Germany;

MGAB–Muzeul Național de Istorie Naturală “Grigore Antipa”, Bucharest, Romania;

NHMUK–Natural History Museum, London, United Kingdom;

NHMW–Naturhistorisches Museum, Vienna, Austria;

TLMF–Tiroler Landesmuseum Ferdinandeum, Hall in Tirol, Austria;

ZSM–Zoologische Staatssammlung, Munich, Germany.

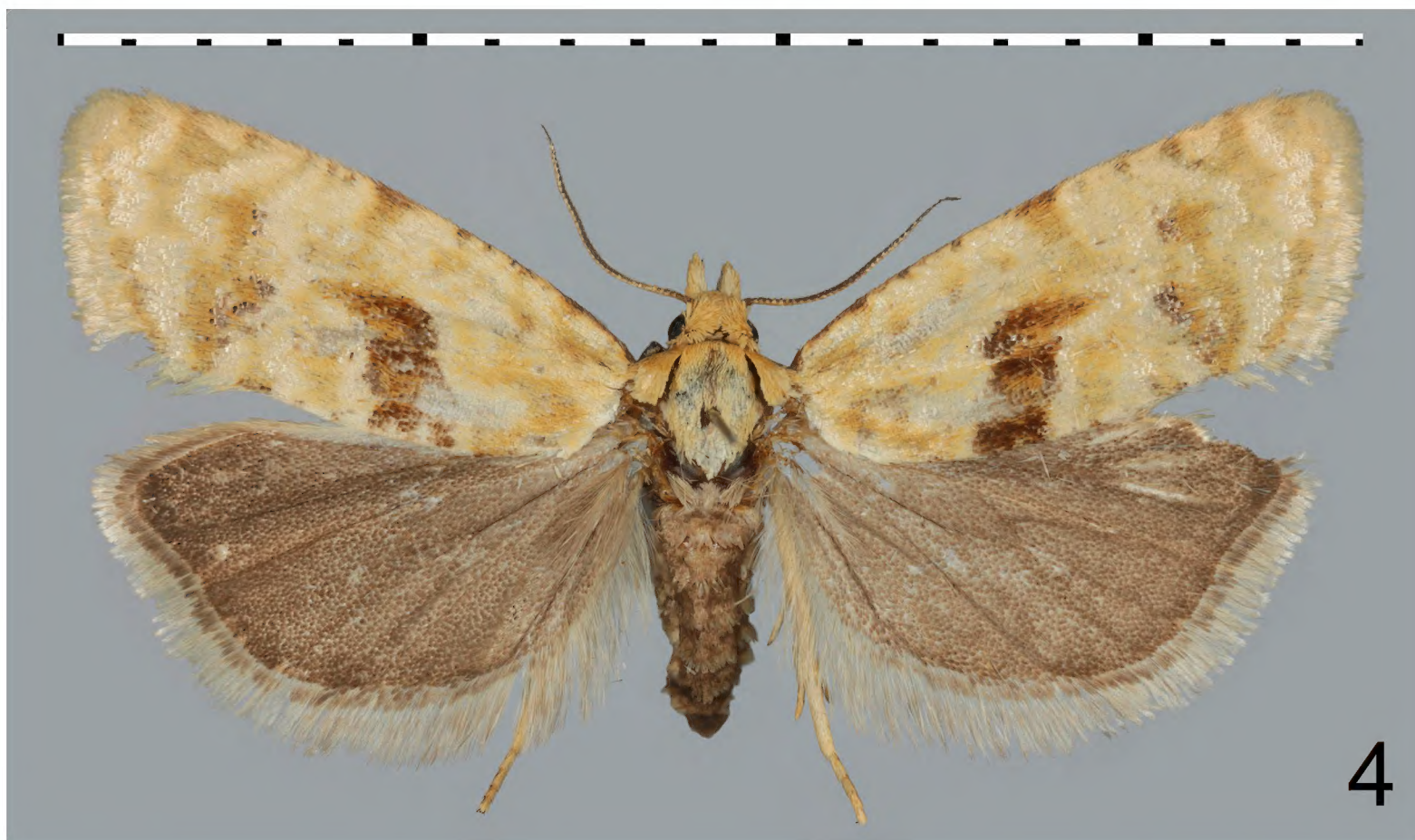
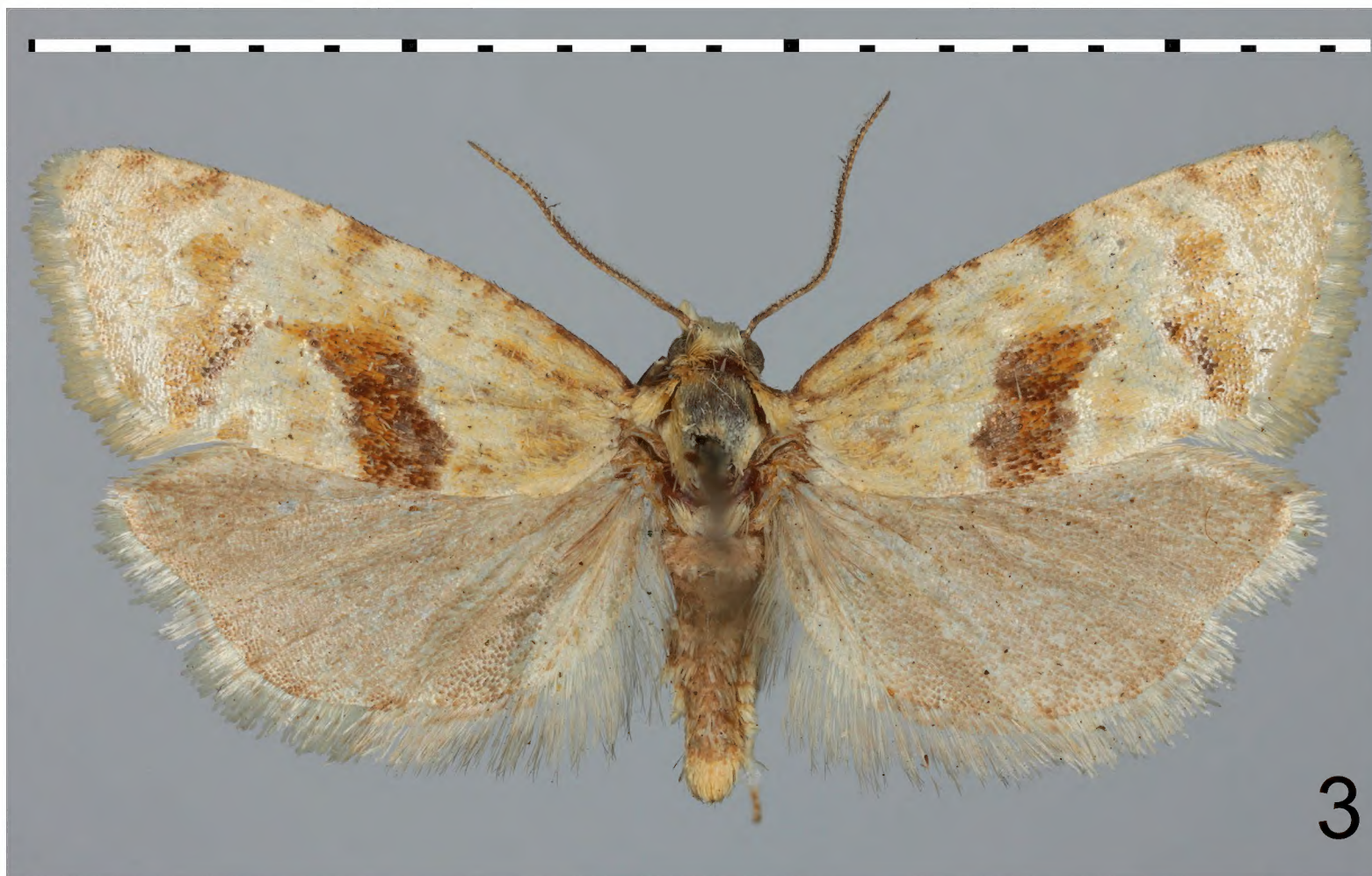
Results

The *C. perfusana* species group can be defined by a combination of the following characters. Adult (Figs 1–8) medium sized, the reticulate pattern of the forewing varying from conspicuous to barely discernible, with reduced sexual dimorphism, male forewing without costal fold and hindwing without costal roll, female hindwing usually with 3 bristles in the frenulum. The male genitalia (Figs 9–12) of all taxa are very similar, possessing a short, wide and tapering tegumen ending in a short terminal process similar to an uncus (pseudo-uncus); lobe-like socius covered with medium to long setae; short, wide and tapering valva, densely covered with setae on the inner surface and margins, costa varying from slightly concave to convex, sacculus short (about 1/3 length of valva) without a process, cucullus round; median process of transtilla long, wide and strongly sclerotized, apically with a group of small thorns; rod-like vinculum; membranous saccus; caulis with ventro-lateral folds; phallus about of the length of valva with tapering ventral phallic process and single non-deciduous, aciculate cornutus, half as long as phallus basally or latero-basally attached. The female genitalia (Figs 13–16) possess a sterigma with wide lateral



Figures 1, 2. *Cochylimorpha perfusana* (Guenée, 1845), adults: **1.** ♂, France, Hautes Alpes RN05, La Grave 3 km E, 1700 m, 4–5.vi.2003, DNA sample 25901 Lepid Phyl [failed], J. Junnilainen leg. & coll.; **2.** ♀, Austria, without further data, slide Buchner, museum-ID MV 20076, J. Mann leg., NHMW; photographs P. Buchner.

sides and strengthened middle, with distinct anteostial sclerite, densely covered with microspines; wide ostium; short ductus bursae; and variable shaped corpus bursae with signum and accessory bursa. The species inhabit open meadows (Figs 37, 39, 46) from the lowlands up to 2100 m. There is a single generation per year; larvae seem to be confined to *Centaurea* (Asteraceae) species; adults fly during the day and are rarely attracted to light; and the species group has a European distribution.



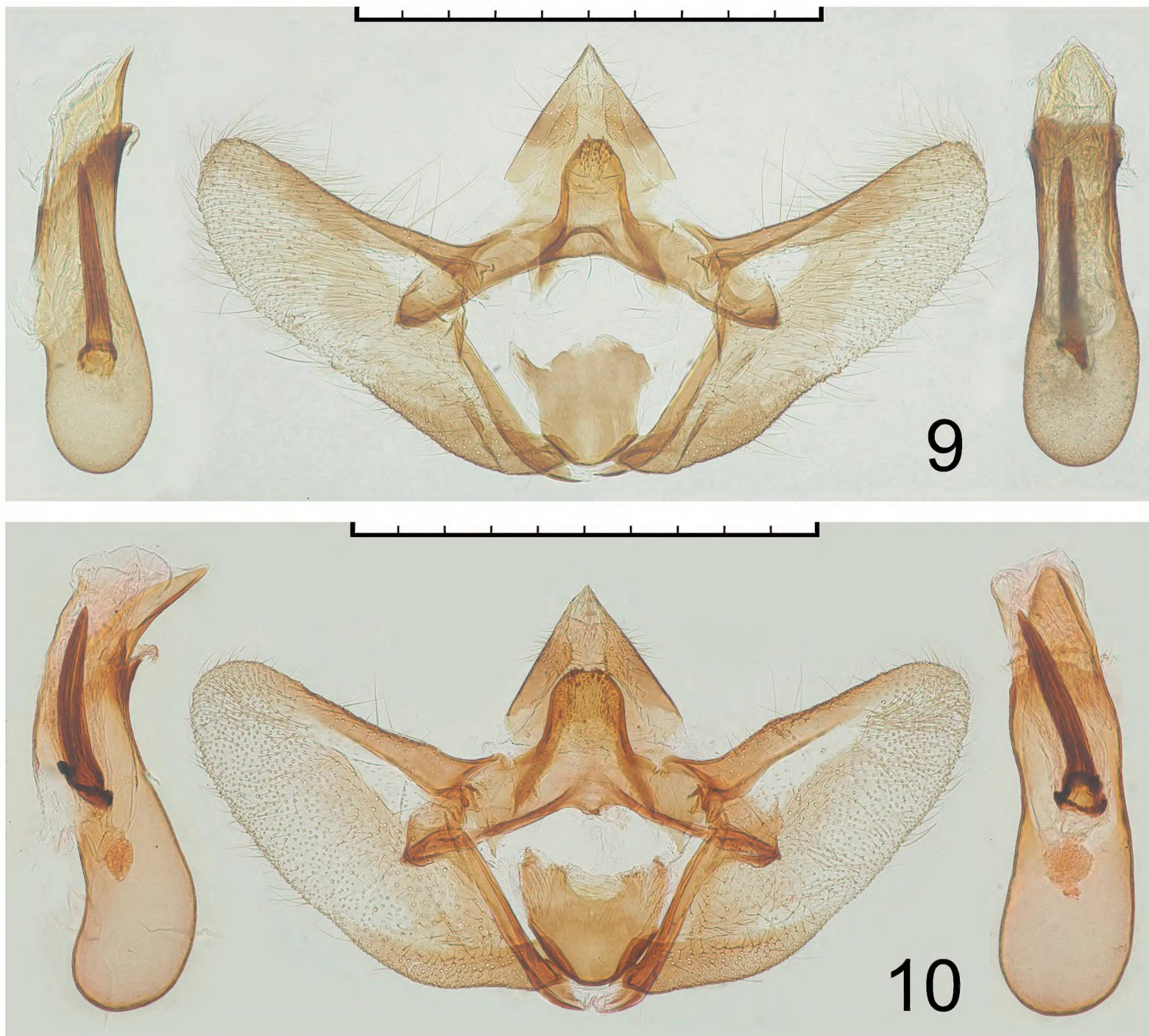
Figures 3, 4. *Cochylimorpha dorsimaculana* (Priessecker, 1908), sp. rev., adults: **3.** ♂, Lower Austria, Retz, 17.vi.1911, slide Buchner, museum-ID: MV 20072, F. Priessecker leg., NHMW; **4.** ♀, Lower Austria, Oberloiben, 300 m, larva leg. 19.iv.2008 in flower-head of *Centaurea triumfettii* All., moth emerged 10.v.2008, P. Buchner leg., cult. & coll.; photographs P. Buchner.



Figures 5, 6. *Cochylimorpha bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov., adults: **5.** Paratype ♂, Romania, Southern Carpathians, Bucegi Mountains, Jepii valley, 1800 m, 9.vii.2013, DNA sample TLMF Lep 28750 (685[0n]), S. & Z. Kovács leg. & coll.; **6.** Paratype ♀, same data as fig. 5, but 11.viii.2005, DNA sample TLMF Lep 27415 [failed]; photographs P. Buchner.



Figures 7, 8. *Cochylimorpha callosana* (Herrich-Schäffer, 1856), sp. rev., adults: **7.** ♂, Croatia, Velebitski, 700 m, 5.vi.2008, J. Junnilainen leg. & coll.; **8.** ♀, Slovenia, Senožeče, 500 m, 30.v.2008, slide Buchner w3563, DNA sample TLMF Lep 32487 (658[0n]), J. Junnilainen leg. & coll.; photographs P. Buchner.

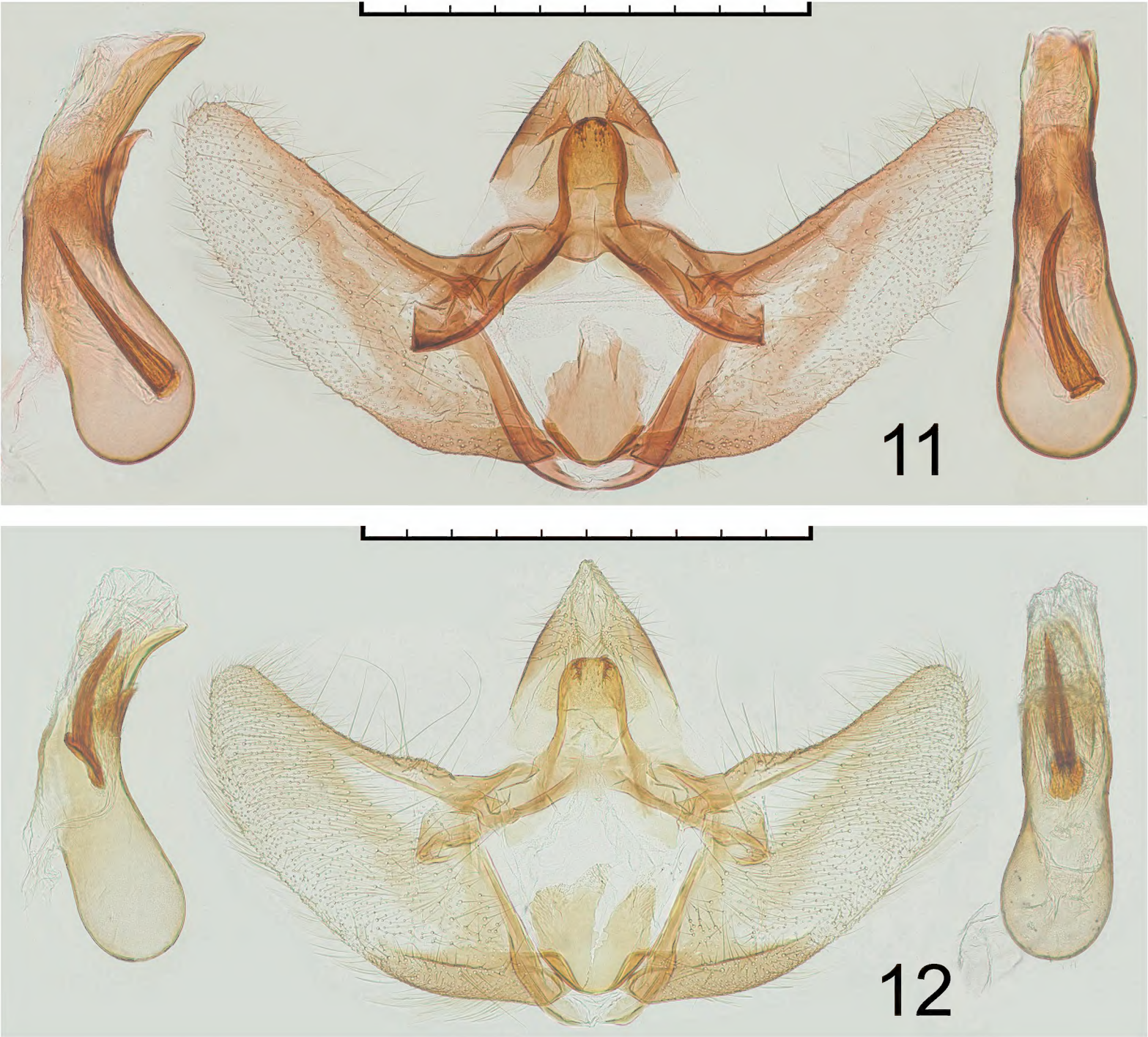


Figures 9, 10. Male genitalia of the *Cochylimorpha perfusana* species group, left: phallus in lateral view, centre and right: ventral view: **9.** *C. perfusana* (Guenée, 1845), Austria Superior, Grosser Pyhrgas, 1600 m, 10.vii.1939, slide Buchner, museum-ID: MV 20071, J. Klimesch leg., NHMW; **10.** *C. dorsimaculana* (Preissecker, 1908), sp. rev., Lower Austria, Retz, 17.vi.1911, slide Buchner, museum-ID: MV 20072, F. Preissecker leg., NHMW. Scale bar: 1 mm. Photographs P. Buchner.

Key to the *Cochylimorpha perfusana* species group, based on external morphology

- 1 The yellowish white ground colour of the forewing only slightly contrasting with the indistinct, slightly brownish yellow reticulate pattern, the only distinct marking is the large, yellowish brown dorsal blotch with admixture of brown scales (Figs 3, 4, 38) *C. dorsimaculana*
- The reticulate pattern of the forewing is distinct and extensive 2
- 2 The yellowish brown reticulate pattern forms an indistinct basal blotch, distinct median transverse fascia, subapical blotch, subterminal blotch and slender terminal fascia, all with admixture of brown scales (Figs 5, 6, 43) *C. bucegiana* sp. nov.
- The markings of the forewing consist of a conspicuous reticulate pattern 3

- 3
- The straw-yellow markings are of irregular forms, extended, with admixture of scattered brown scales, the yellowish white spots of the ground colour are unequal in size and of irregular forms (Figs 7, 8, 47).....*C. callosana*
-
- The fine and smooth olive-green markings lack admixture of brown scales, the off-white spots of the ground colour are roundish and almost uniformly small (Figs 1, 2, 17)
.....*C. perfusana*



Figures 11, 12. Male genitalia of the *Cochylimorpha perfusana* species group, left: phallus in lateral view, centre and right: ventral view: **11.** *C. bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov., paratype, Romania, Southern Carpathians, Bucegi Mountains, Jepii valley, 1800 m, 9.vii.2013, slide Buchner m3565, S. & Z. Kovács leg. & coll.; **12.** *C. callosana* (Herrich-Schäffer, 1856), sp. rev., Croatia, Fiume (= Rijeka), slide Buchner, museum-ID: MV 20073, NHMW. Scale bar: 1 mm. Photographs P. Buchner.

Key to the *Cochylimorpha perfusana* species group, based on male genitalia

- 1
- Phallus straight, apex of median process of transtilla tapering (Figs 9, 18–20, 28)
.....*C. perfusana*
-
- Phallus curved, apex of median process of transtilla round..... **2**

- 2 Phallus S-shaped, median process of transtilla rather short and very wide (Figs 10, 21–22, 29) *C. dorsimaculana*
- Phallus ventrally curved at about 30 degrees, median process of transtilla long and wide (Figs 11, 12, 23–27, 30, 31) **3**
- 3 Phallus long, ventral phallic process long, median process of transtilla with slightly convex margins (Figs 11, 23, 24, 30)..... *C. bucegiana* **sp. nov.**
- Phallus short, ventral phallic process short, median process of transtilla with slightly concave margins (Figs 12, 25–27, 31) *C. callosana*

Key to the *Cochylimorpha perfusana* species group, based on female genitalia

- 1 Papillae anales lanceolate and densely covered with short setae; the apophyses stout (Figs 13, 14, 16, 32–33, 35) **2**
- Papillae anales wide, round and densely covered with medium-long and long setae; the apophyses slender (Figs 15, 34)..... *C. bucegiana* **sp. nov.**
- 2 Signum of corpus bursae formed by a sclerotized plate and a large group of thorns (Figs 14, 16, 33, 35) **3**
- Signum a very weakly sclerotized plate with distinct longitudinal folds in the posterior 1/3 of corpus bursae (Figs 13, 32)..... *C. perfusana*
- 3 Corpus bursae about 2 times as long as wide, the sclerotized plate of signum large, occupying the posterior ½ of bursa (Figs 16, 35)..... *C. callosana*
- Corpus bursae about 1 ½ times as long as wide, the sclerotized plate of signum smaller, occupying the posterior 1/3 of bursa (Figs 14, 33) *C. dorsimaculana*

Cochylimorpha perfusana (Guenée, 1845)

Figs 1, 2, 9, 13, 17, 18–20, 28, 32

Argyrolepis perfusana Guenée, 1845, Annales de la Société entomologique de France. Deuxième Série 3: 302. Locus typicus: Austrian Alps and Dauphiné in France.

Cochylis perfusana Herrich-Schäffer 1851: 183.

Euxanthia perfusana Kennel 1913: 320, pl. 14 fig. 19.

Stenodes perfusana Razowski 1970: 162, colour pl. 8 fig. 79-1, pl. 59 fig. 79, pl. 127 fig. 79.

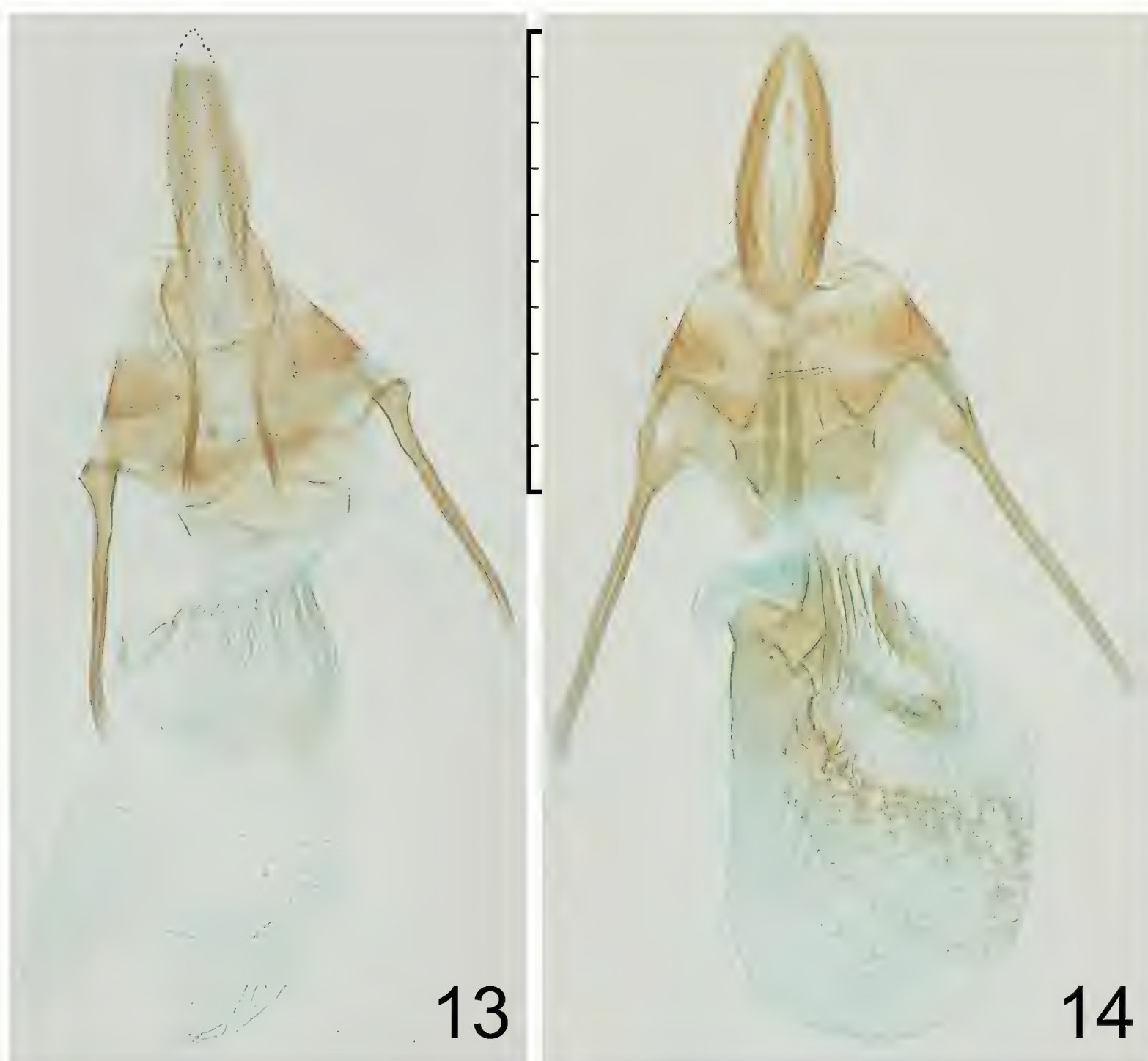
Cochylimorpha perfusana Razowski 1991: 105; 2001: 36, colour pl. 3 fig. 51; 2002: 43, colour pl. 5 fig. 91; 2009: 37, colour pl. 3 fig. 97.

Type material examined. *Argyrolepis perfusana* Guenée, 1845: **Lectotype.** ♀, Type; Type Guenée; *perfusana* Gn.; Paravicini Coll. B.M. 1937–383; NHMUK 013700330; NHMUK (Fig. 17).

Additional material examined. 38 ♂, 14 ♀, Austria: 1 ♂, Wiener Schneeberg, ex coll. E. Frank–Regensburg in coll. Osthelder, ZSM; 1 ♂, Schn[ee]berg, Krone [leg.], NHMW; 1 ♀, genit. slide Buchner (museum-ID: MV 20074), Mann [leg.], NHMW; 1 ♂, Gr[oss] Glockn[er], Krone [leg.], *Stenodes perfusana* Gn., det.: J. Razowski, 1961, NHMW; 1 ♀ (as *callosana*), Led[erer leg.], [1]853, NHMW; 1 ♂, 1 ♀, Schneeberg, [18]56, ex coll. A. Caradja, MGAB 118296; 1 ♀, Schneeberg, 19.vii.[18]94, 58, *C. Perfusana* HS., ex coll. A. Caradja, MGAB 118296; 1 ♂, Austria Superior, Gr[osser] Pyhrgas, 1600 m, 10.vii.1939, genit. slide Buchner (museum-ID: MV 20071), J. Klimesch leg., NHMW; 1 ♂, Austria Superior, Gr[osser] Pyhrgas, 1600 m, 4.viii.1940, J. Klimesch leg., DNA sample ZSM_46193_A01 [failed], ZSM; 1 ♂, Lower Austria, Hochkar, Schmalzmauer, 1750 m, 30.vi.2012, DNA sample BC_LSNOE_02140 (638[0n]), W. Stark leg. & coll.;

Bulgaria: 1 ♂, Southern Pirin, Orelek, 1500 m, 29.v.2006, J. Junnilainen leg. & coll.; 11 ♂, Southern Pirin, Orelek, 2000 m, 4.vii.2014, genit. slide Junnilainen 201710, DNA sample 25898 Lepid Phyl (658[0n]), J. Junnilainen leg. & coll.; 1 ♀, Pirin Mts, Orelek Mt, 24.vi.2014, genit. slide Tokár 12280, Z. Tokár leg. & coll.;

France: 1 ♂, 1 ♀, La Grave, Alpes, vi.[18]99, ex coll. A. Caradja, MGAB 118296; 1 ♂, La Grave, 1.vi.[18]99, ex coll. A. Caradja, MGAB 118296; 1 ♂, H[au]tes Alpes, 4.viii.[18]99, genit. slide Obratzsov 786, Chrétien leg., DNA sample ZSM_46193_A02 (145[0n]), ZSM; 1 ♀, Südfrankreich [=Southern France], 19.vi.1910, genit. slide Buchner (museum-ID: MV 20075), NHMW; 1 ♀, Südfrankreich [=Southern France], 10.vi.1912, NHMW; 2 ♂, Hautes Alpes RN05, La Grave 3 km E, 1700 m, 4–5.vi.2003, DNA sample 25901 Lepid Phyl [failed], genit. slide Junnilainen 201709 ♂, J. Junnilainen leg. & coll.; 1 ♂, 3 ♀, Hautes Alpes, La Grave, 20.v.2007, genit. slide Junnilainen 201723 ♀, DNA sample ♂ TLMF Lep 32488 [failed], DNA sample ♀ Junnilainen_46193_H07 (550[1n]), J. Junnilainen leg. & coll.;

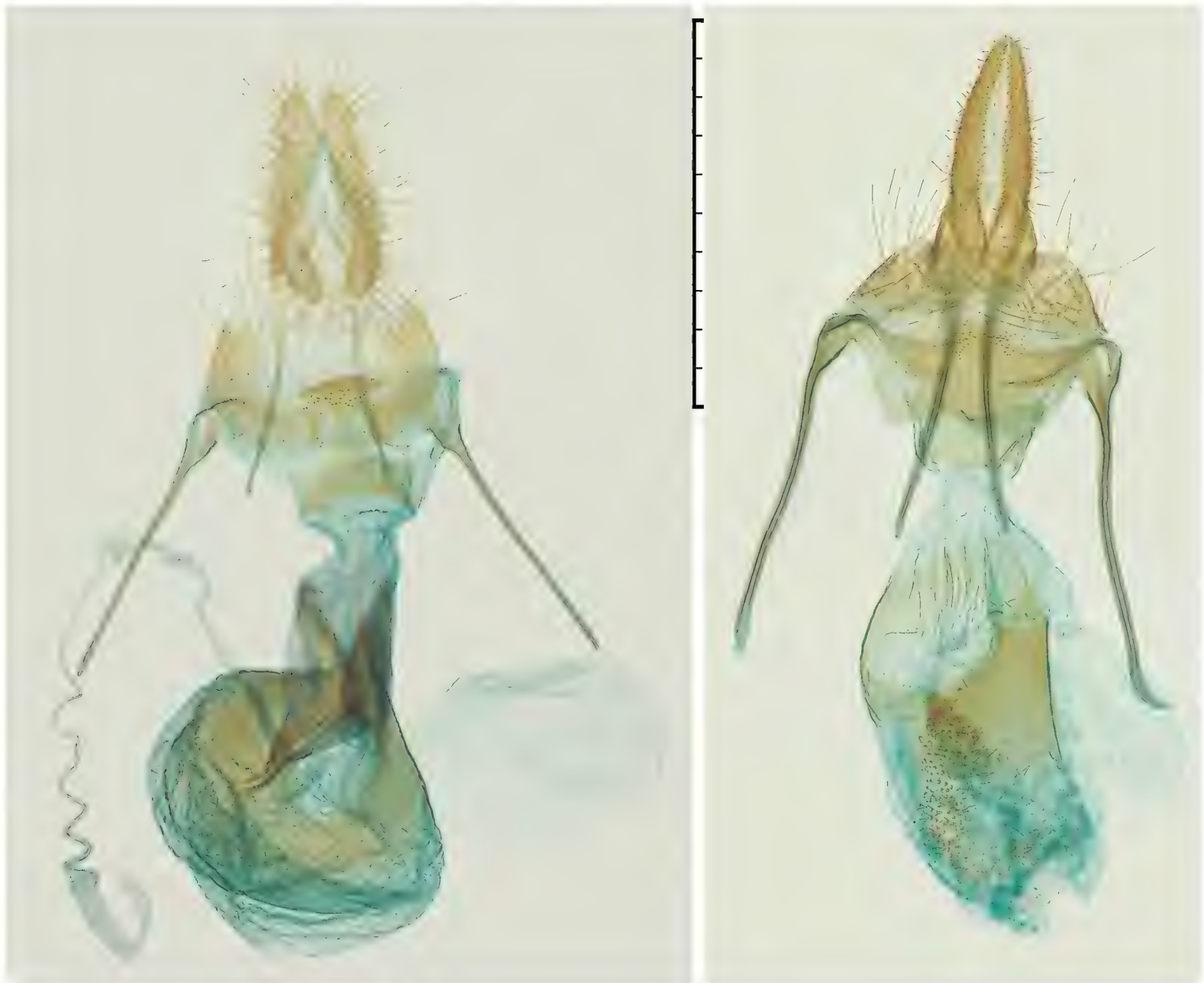


Figures 13, 14. Female genitalia of the *Cochylimorpha perfusana* species group: **13.** *C. perfusana* (Guenée, 1845), Austria, without further data, slide Buchner, museum-ID: MV 20074, J. Mann leg., NHMW; **14.** *C. dorsimaculana* (Priessecker, 1908), sp. rev., Lower Austria, Spitz, 2.vii.1922, slide Buchner, museum-ID: MV 20076, NHMW. Scale bar: 1 mm. Photographs P. Buchner.

Romania: 1 ♂, Carpații Orientali, Cheile Bicazului, 14–16.vi.1984; 1 ♂, Ibidem, 4.vii.1987, genit. prep. Kovács 285; 8 ♂, 3 ♀, Ibidem, 26–28.vi.1989, genit. prep. Kovács 1345/♀; 1 ♂, Ibidem, 4.vii.2012, DNA sample TLMF Lep 28732 (658[0n]), all S. & Z. Kovács leg. & coll.;

Serbia: 1 specimen, Serbia, ex coll. Staudinger, MfN.

Diagnosis. Externally, *Cochylimorpha perfusana* is characterized by a fine, smooth, regularly dispersed olive-green reticulate pattern that lacks an admixture of brown scales, and the roundish, almost uniformly small, yellowish white spots of ground colour. In the male genitalia the tegumen has convex margins and an elongated and pointed terminal process; the valva is slightly variable; the median process of the transtilla wide and long, has parallel margins and a tapering apex; the caulis has shallow ventro-lateral folds; and the phallus is straight with one long, straight, latero-basally attached cornutus. In the female genitalia the papillae anales are lanceolate and densely covered with strong short setae and a longitudinal row of very long setae; the apophyses are stout;



Figures 15, 16. Female genitalia of the *Cochylimorpha perfusana* species group: **15.** *C. bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov., paratype, Romania, Southern Carpathians, Bucegi Mountains, Jepii valley, 1800 m, 9.vii.2013, slide Buchner w3567, S. & Z. Kovács leg. & coll.; **16.** *C. callosana* (Herrich-Schäffer, 1856), sp. rev., Slovenia, Senožeče, 500 m, 30.v.2008, slide Buchner w3568, J. Junnilainen leg. & coll. Scale bar: 1 mm. Photographs P. Buchner.

the ductus bursae is very short; and the corpus bursae has the signum in the posterior 1/3, in the form of a very weakly sclerotized plate with distinct longitudinal folds.

Redescription. Adult, male (Fig. 1). Head. Frons and vertex covered with very pale olive-green scales. Labial palpus about 2.5 times length of diameter of eye, first segment short, second segment long and widened distally, third segment short, all covered with off-white scales medially, light olive-green dorsally, a mixture of olive-green and brown scales laterally, and long brown scales ventrally. Antenna filiform, reaching $\frac{1}{2}$ length of the forewing, brown, dorsally covered with off-white scales.

Thorax. Dorsally covered with light olive-green scales, long and erect in posterior 1/3, tegula pale olive-green laterally edged with a row of long off-white scales. Forewing length 7–9 mm, wingspan 15.5–19.5 mm. Forewing almost 3 times as long as wide, trapezoidal, only slightly widening from base to apex, costal margin without costal fold, slightly convex in basal 1/5, remainder straight, apex rounded, termen straight; almost evenly scattered small spots of off-white ground colour evenly distributed with fine and distinct pale olive-green reticulate pattern, lacking admixture of brown scales. Fringe pale olive-green. Hindwing without costal roll, dark grey, fringe off-white with light grey basal line. Underside of thorax and forewing brown, yellowish white distally on costal margin, along basal $\frac{1}{2}$ of subcostal vein and fringe; hindwing light grey, with an indistinct light brown reticulate pattern in apical 1/3, light yellow along M_2 vein, fringe off-white. Legs brown, but fore- and mid-leg medially, hind-leg on both dorsal and ventral surfaces covered with off-white scales.

Abdomen. Dorsally uniformly covered with olive-green, ventrally a mixture of off-white and olive-green scales, each segment distally edged with a row of long, off-white scales, last segment off-white.

Variation. The spots of ground colour may vary from small and regularly scattered to fairly large and irregularly scattered in median and subterminal areas of forewing. Both the olive-green markings and the off-white ground colour may vary from greyish to yellowish.

Male genitalia (Figs 9, 18–20, 28). Tegumen tapering distally, margins convex, with elongated and pointed terminal process. Socius long, subtriangular lobe at margin of tegumen, sparsely covered with long setae. Median process of transtilla long and wide, parallel-sided, tapering distally

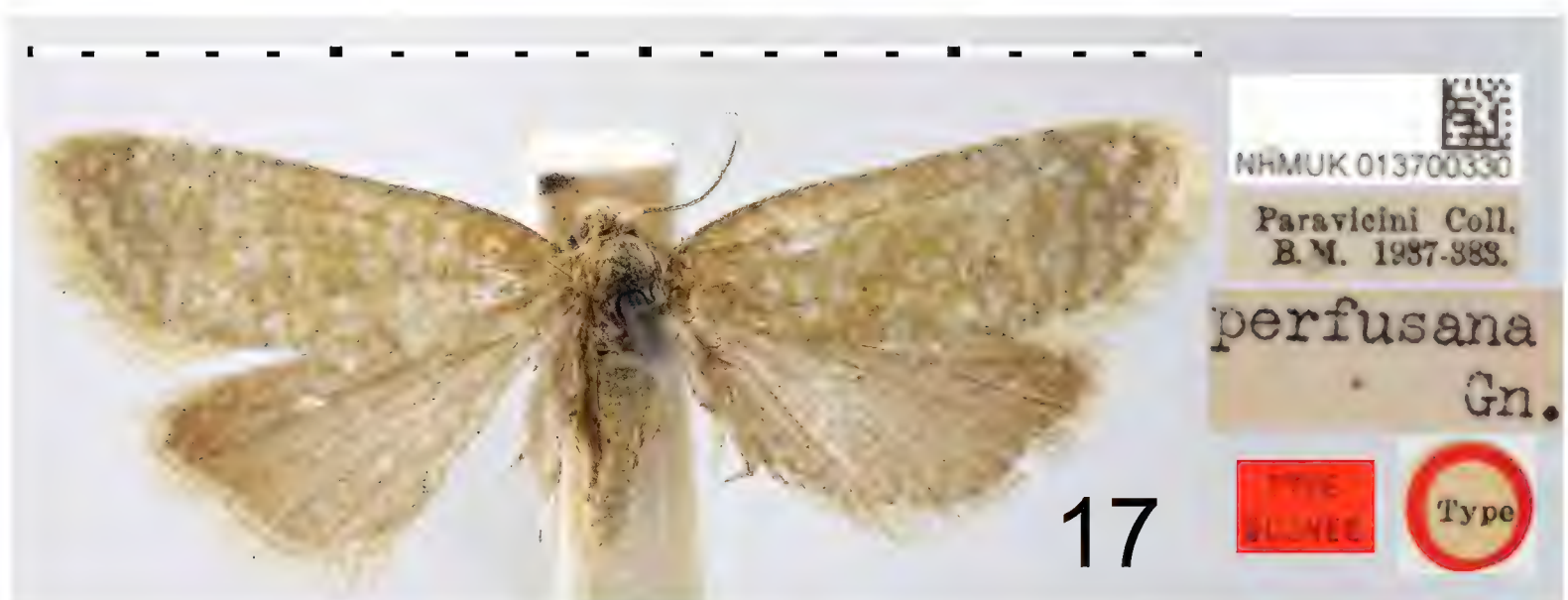
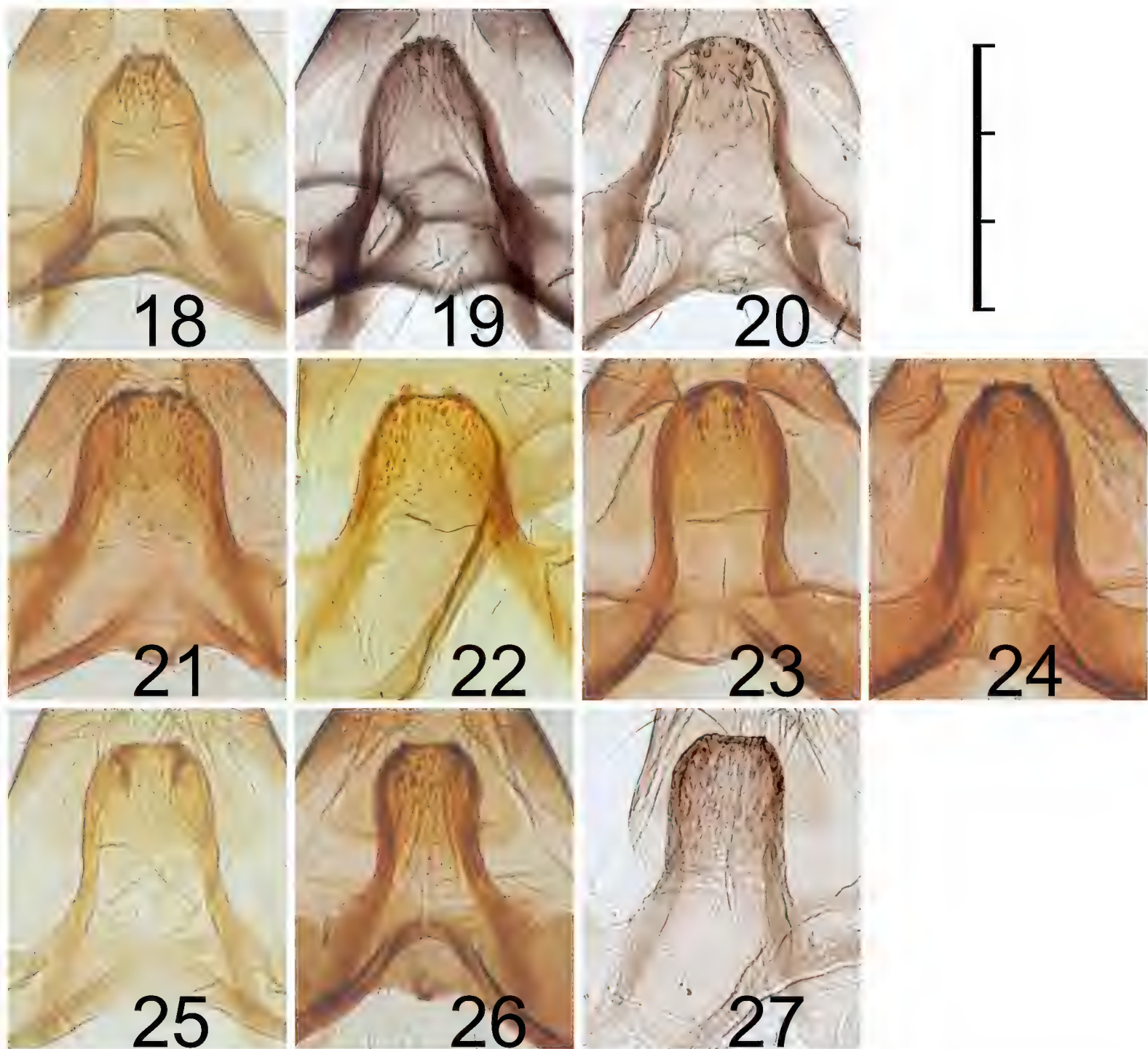
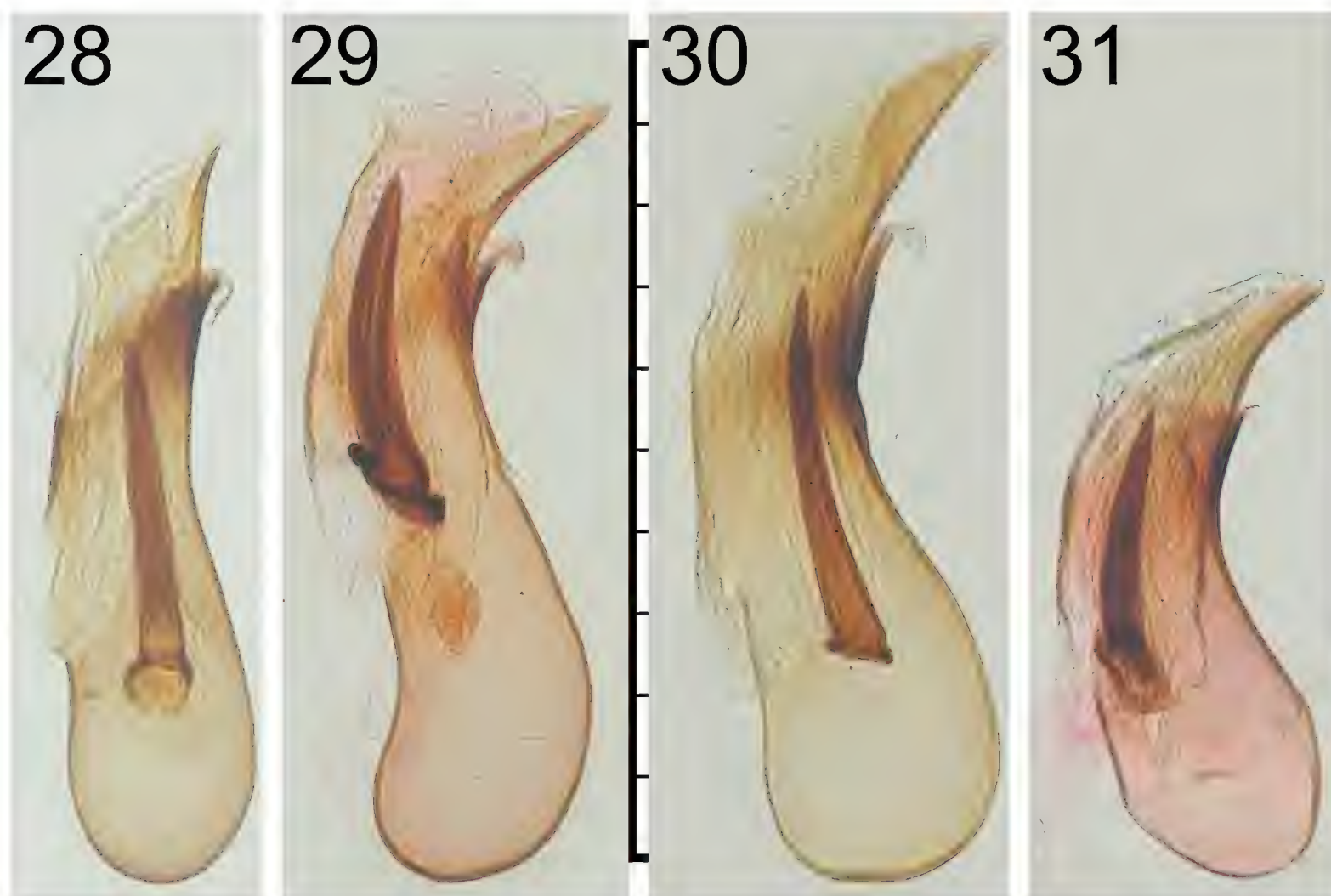


Figure 17. *Argyrolepia perfusana* Guenée, 1845, lectotype ♀ and its labels, photograph and courtesy of David C. Lees and with the kind permission of The Trustees of NHMUK.



Figures 18–27. Variation of male genitalia within the *Cochylimorpha perfusana* species group, median process of the transtilla in ventral view: **18–20.** *C. perfusana* (Guenée, 1845): **18.** Same data as fig. 9; **19.** France, Hautes Alpes RN05, La Grave 3 km E, 1700 m, 4–5.vi.2003, slide Junnilainen 201709, J. Junnilainen leg. & coll.; **20.** Bulgaria, Pirin Mountains, Orelek, 2000 m, 4.vii.2014, slide Junnilainen 201710, J. Junnilainen leg. & coll.; **21, 22.** *C. dorsimaculana* (Priessecker, 1908), sp. rev.: **21.** same data as fig. 10; **22.** Paralectotype, Lower Austria, Gaisberg, 9.vi.1907, slide Razowski 3427, museum-ID: MV 2143, F. Priessecker leg., NHMW; **23, 24.** *C. bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov.: **23.** Paratype, same data as fig. 11; **24.** Paratype, Romania, Southern Carpathians, Bucegi Mountains, Jepii valley, 1800 m, 11.viii.2005, slide Buchner m3564, S. & Z. Kovács leg. & coll.; **25–27.** *C. callosana* (Herrich-Schäffer, 1856), sp. rev.: **25.** Same data as fig. 12; **26.** Croatia, Velebitski, 700 m, 5.vi.2008, slide Buchner m3566, J. Junnilainen leg. & coll.; **27.** Same data as fig. 26, but slide Junnilainen 201711; Scale bar: 0.3 mm; **18, 21–26.** Photographs P. Buchner; **19, 20, 27.** Photographs J. Junnilainen.

with group of small thorns. Valva slender, elongated, costa slightly convex in basal 1/3, sacculus convex, 1/3 length of valva, ventral margin of valva slightly concave, cucullus round. Vinculum rod-like, straight, narrow dorsally, slightly widening ventrally, inwardly curved terminally. Saccus membranous. Caulis with short, shallow, ventro-lateral folds. Phallus slightly shorter than valva,



Figures 28–31. Phalli of the *Cochylimorpha perfusana* species group in lateral view, compared, same data as Figs 9, 10, 24, 26: **28.** *C. perfusana* (Guenée, 1845), straight; **29.** *C. dorsimaculana* (Preissecker, 1908), sp. rev., S-shaped; **30.** *C. bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov., long and ventrally curved; **31.** *C. callosana* (Herrich-Schäffer, 1856), sp. rev., short and ventrally curved. Scale bar: 1 mm. Photographs P. Buchner.

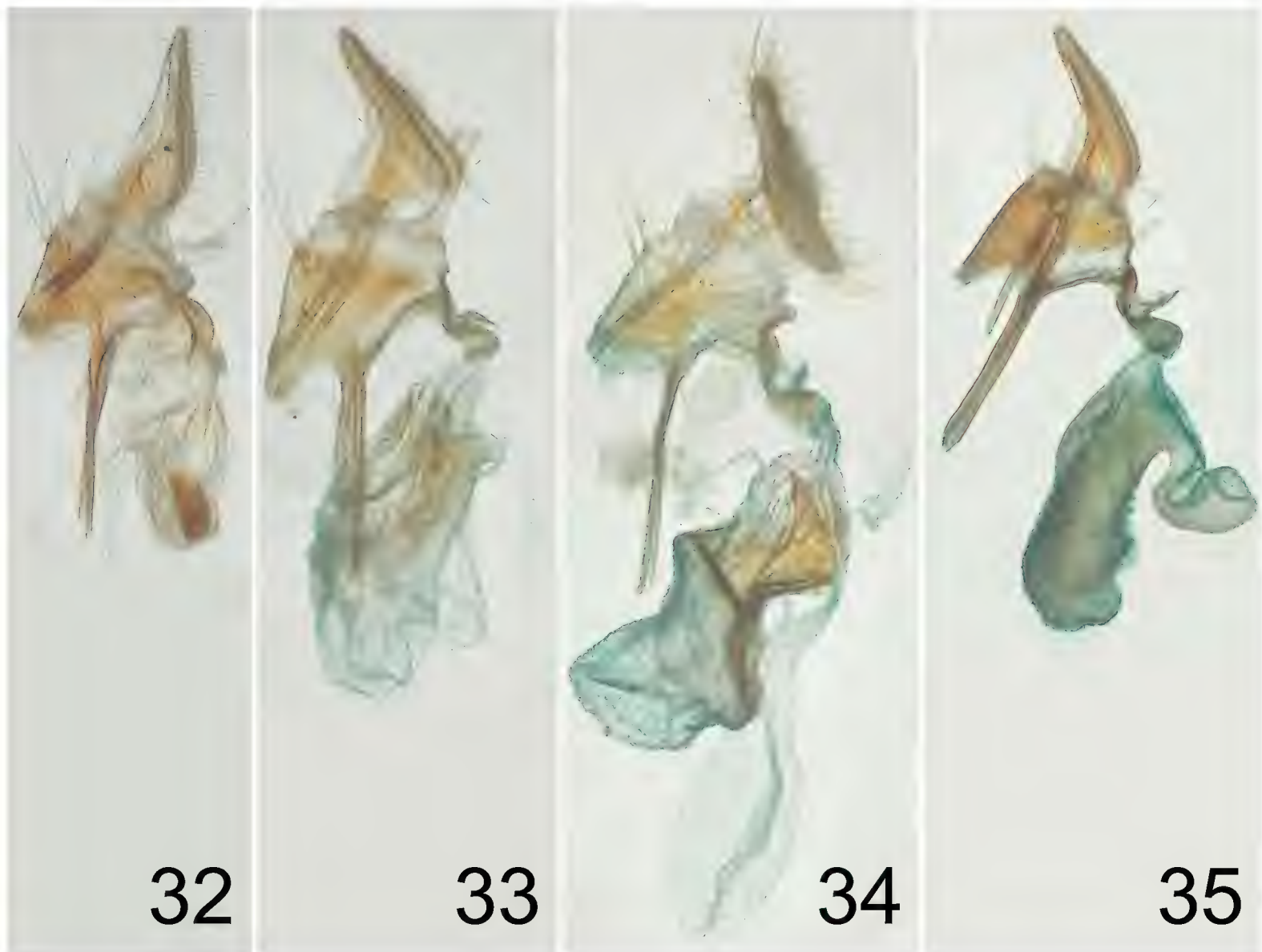
straight, coecum slightly widened, ventral phallic process short, tapering; vesica with a single stout, straight, aciculate non-deciduous cornutus, attached latero-basally with a widened round base, slightly longer than $\frac{1}{2}$ length of phallus.

Variation. Length of terminal process of tegumen slightly variable, costa of valva straight, ventral edge varying from slightly concave to straight or slightly convex. Cornutus sometimes with slightly curved distal apex.

Female (Figs 2, 17). Forewing length 7–8.5 mm, wingspan 15–18.5 mm, generally slightly shorter and widening more from base to apex than that of male. Underside of forewing brown with yellowish white reticulate pattern on the apical $\frac{1}{3}$. Hindwing with 3 bristles in the frenulum.

Variation. Hindwing grey with indistinct white spots along the external and dorsal margin, rarely with 2 bristles in the frenulum on one or both sides.

Female genitalia (Figs 13, 32). Papilla analis about $1\frac{1}{2}$ as long as segment VIII, narrow, elongated, lanceolate, densely covered with strong, short setae, with row of 10–13 strong, very long setae parallel to lateral edge. Posterior apophysis $1\frac{1}{2}$ as long as segment VIII, with wide, weakly sclerotized posterior $\frac{1}{2}$ and rod-like, stout, strongly sclerotized anterior $\frac{1}{2}$. Segment VIII with group of strong and very long setae along and parallel to posterior margin. Anterior apophysis $1\frac{1}{2}$ as long as posterior apophysis, rod-like, stout, strongly sclerotized, except its anterior end. Sterigma with wide lateral sides and strongly strengthened middle covered with tiny microspines.



Figures 32–35. Free floating female genitalia of the *Cochylimorpha perfusana* species group in left lateral view: **32.** *C. perfusana* (Guenée, 1845), Southern France, 19.vi.1910, slide Buchner, museum-ID: MV 20075, NHMW; **33.** *C. dorsimaculana* (Preissecker, 1908), sp. rev., same data as fig. 14; **34.** *C. bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov., same data as fig. 15; **35.** *C. callosana* (Herrich-Schäffer, 1856), sp. rev., same data as fig. 16; note the similar shape of the papilla analis and of the apophyses to all species except *C. bucegiana* sp. nov., photographs P. Buchner.

Anteostial sclerite large, indistinct, roundish, with microspines. Ostium $\frac{2}{3}$ width of segment VIII. Antrum narrow, $\frac{1}{2}$ as wide as segment VIII, weakly sclerotized. Ductus bursae $\frac{2}{3}$ as wide as antrum, very short, membranous. Corpus bursae roundish, as wide as segment VIII, $1\frac{1}{2}$ as long as wide, membranous, signum a very weakly sclerotized plate in the posterior $\frac{1}{3}$ of bursa, with distinct longitudinal folds. Accessory bursa membranous, about $\frac{1}{3}$ of size of corpus bursae, with long and narrow postero-ventral join.

Molecular data (Fig. 36). BIN URI: BOLD:ADI4764. The intraspecific divergence is 1.11% ($n = 2$), and it shares its BIN with the nearest neighbour, *C. dorsimaculana*, at a distance of 1.07%. The minimum distance to *C. callosana* is 3.13% and to *C. bucegiana* sp. nov. 3.73%.

Biology. According to Razowski (1970: 162), host-plants are *Centaurea stoebe* L. and *C. triumfettii* All. (Asteraceae), however, the latter was confirmed only for *C. dorsimaculana* (P. Buchner personal observation). Moths are on wing from the very end of May to the beginning of August. The authors collected most of the specimens in the evening and early morning by net, usually around places with some *Centaurea* (Asteraceae). Some specimens were also attracted to light.

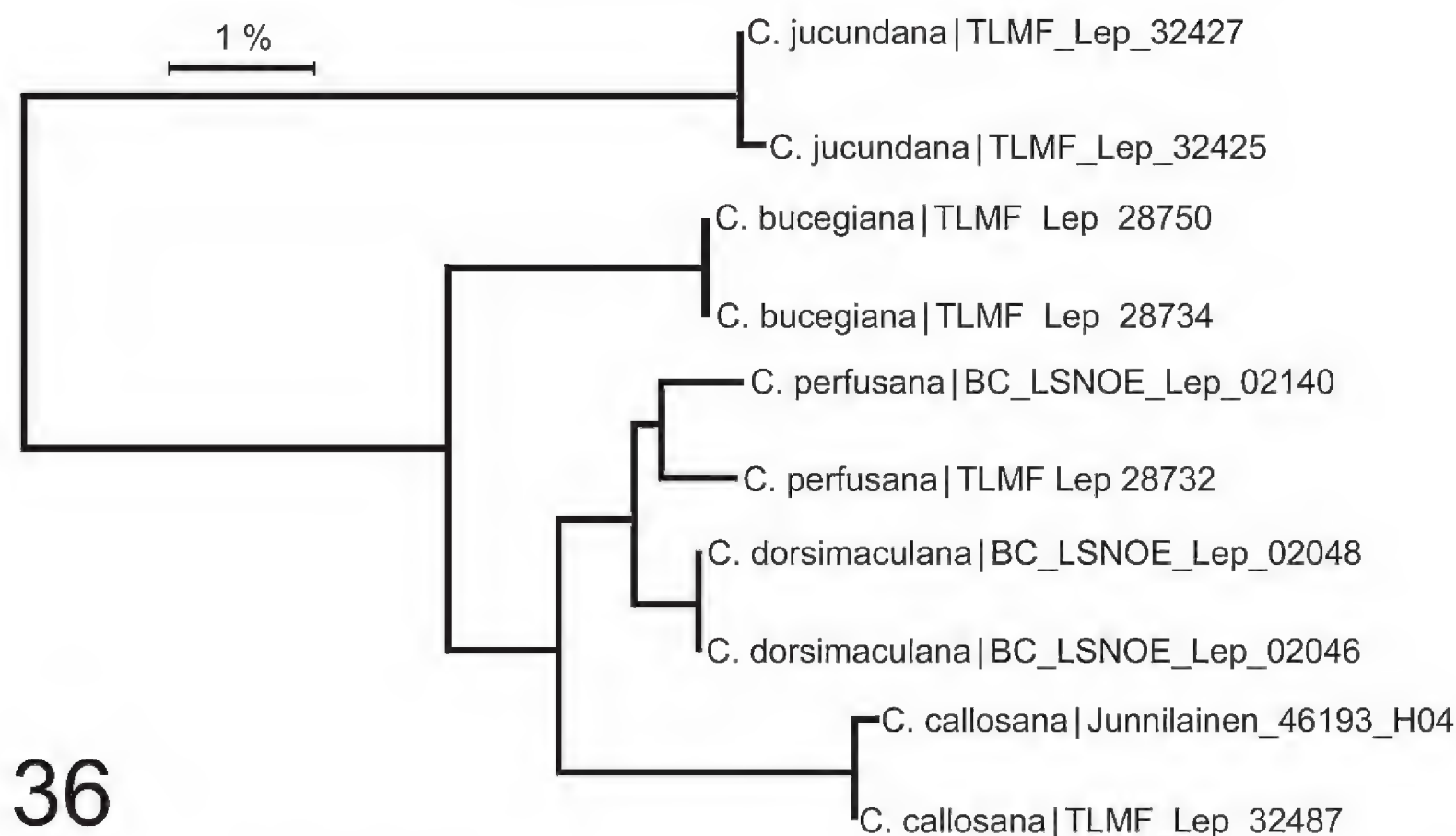


Figure 36. Neighbour-joining tree (Kimura 2 parameter) comprising sequences longer than 600 bp of the *Cochylimorpha perfusana* species group, with *Cochylimorpha jucundana* (Treitschke, 1835) as outgroup (details of Sample ID, Process ID and GenBank Accession in Appendix 1).

Habitat. Exposed mountain and high-mountain meadows on limestone substrate where its host-plants are abundant, at elevations from about 550 m to Dauphiné (France) up to 1700–1800 m in the Alps (France, Austria, Switzerland), between 1200–1300 m in the Eastern Carpathians (Romania) (Fig. 37) and at 2000–2100 m in the Pirin Mountains (Bulgaria).

Distribution (Fig. 48). Widespread in scattered localities in mountain areas of Europe. We examined voucher specimens from the Austrian Alps and France (type localities), Eastern Carpathians (Romania), Pirin Mountains (first record for Bulgaria) and only a historic specimen from Serbia; for details see above the examined material.

Further material was identified from figures in the literature or available on the world wide web: Ukraine (Crimea) (Razowski 1970: colour pl. 8 fig. 79-1), however, in our opinion, this may be a misinterpretation of the label data (“Kr.[im], Urspr.[ung], 23.v.[19]01”, Kr. may instead be Krone, the collector); Austria (Oberösterreich, Steiermark, Rax area, Siebenbrunnenkessel) (Razowski 1970: pl. 50 fig. 79, pl. 127 fig. 79; 2001: pl. 3 fig. 51; 2002: pl. 5 fig. 91; 2009: pl. 3 fig. 97; P. Buchner in Lepiforum; W. Stark in BOLD); Romania (Bicaz Gorge) (Kovács and Kovács 2005: 64 fig. 52, 70 fig. 71, 76 fig. 90); Switzerland (Bern, Chasseral, 1285 m; Wallis, Simplon, Engeloch, 3.vii.2021) (R. Bryner in Lepiforum; jaroschacht in iNaturalist); southern France (Hautes-Alpes: Le Monétier-les-Bains, 5.vii.2021; Névache, 14.vi.2022) (Lepertel et al. 2023: 45 fig. 346; L. Decrick in iNaturalist).

Literature data. Guenée (1845: 302) in the original description of the species mentions the entire Austrian Alps and Dauphiné in France as type localities. Staudinger and Wocke (1871: 242) mention the Austrian Alps and Serbia, the latter we can confirm based on a specimen labelled as Serbia, ex coll. Staudinger, deposited in MfN in Berlin (Viola Richter pers. comm.).



Figure 37. Habitat of *Cochylimorpha perfusana* (Guenée, 1845): Romania, Eastern Carpathians, Bicz Gorge, 16.vi.2022, photograph Z. Kovács.

Kennel (1913: 320) reports the Austrian Alps, Serbia and Switzerland. Caradja (1916: 54) mentions La Grave in France. In Razowski (1970: 163; 2001: 37; 2002: 43; 2009: 37, all as *perfusana*) detailed distribution is given, most of which were confirmed by examined material: France, Switzerland and the Schneeberg in Austria refer to *C. perfusana*; records from north-eastern Italy and Croatia (Dalmatia) refer to *C. callosana*; and those from Wachau and Retz in Lower Austria refer to *C. dorsimaculana*. We were not able to confirm the following two: Hardegg may refer to the latter species, being a similar habitat also in Lower Austria; and Romania (Transylvania), specified as *dorsimaculana*, may refer to *C. bucegiana* sp. nov. Razowski (2001: 37) mentions *C. perfusana* from the Czech Republic, which is plausible, but we cannot confirm it. In both the catalogue of the Italian Tortricidae (Trematerra 2003: 51) and the on-line checklist of the fauna of Italy (Stoch 2003), the species is mentioned from northern Italy. In the former, Valle d'Aosta, Piemonte, Lombardia, Trentino-Alto Adige and Friuli-Venezia Giulia are given, the latter without details. Valle d'Aosta, Piemonte and Trentino-Alto Adige are high-mountain habitats which may refer to *C. perfusana*, but we cannot confirm this. All Italian specimens examined in this study, most of them from Friuli-Venezia Giulia and also from Trentino, proved to be *C. callosana*. Records from Lombardia, a low-mountain habitat, may also refer to the latter species, but require re-examination. Two historic specimens from Hungary deposited in ZSM were recorded from Budapest as *C. perfusana* by Fazekas (1994: 40), but these records refer to *C. callosana* (see also that species). Another record of *C. perfusana* from Hungary (Mátra Mountains, 1 specimen from Jászberény and 3 from Nagykáta, Cseh-domb, all F. Buschmann leg., coll. Mátra Múzeum) (Buschmann 2004: 224) was also recently disproved, as all specimens proved to be *Cochylimorpha straminea* (Haworth, 1811) (Buschmann 2022: 159; Fazekas 2022: 118, 120; 2023: 24).

The species was mentioned for the first time from Romania, in Transylvania, as *Euxanthis dorsimaculana* Preiss. by Galvagni and Preissecker (1913: 49), based on the written communication of J. Kennel, and which, in our opinion, may not refer to this species but to *C. bucegiana* sp. nov. This record was also cited by Razowski (1970: 163; 2001: 37). Kovács and Kovács (2005: 88) recorded material from the Bicaz Gorge as forma *perfusana* which refers to this species, but the material from the Bucegi Mountains, mentioned as forma *callosana*, refers to *C. bucegiana* sp. nov. Székely and Cernea (2007: 141) recorded four specimens from the environs of Braşov (Codlea, Vlădeni) and Lacu Roşu, but we consider the record as doubtful, because two of these specimens, one from each of the latter two collecting localities, examined by us proved to belong to *Aethes rubigana* (Treitschke, 1830), and the other two specimens, not examined by us, may also be misidentified. The record by Lesar and Godevič (2010: 77) from Slovenia lacks evidence because it is only based on two old literature sources: Mann (1854: 576), who reported *C. callosana* from Gradischa, which currently is Gradisca d'Isonzo in modern Italy, and Staudinger and Wocke (1871: 242), who mention *C. perfusana* only from the Austrian Alps and Serbia. Jakšić (2016: 140) included *C. perfusana* in the checklist of Serbia referring only to the literature data of Staudinger and Wocke (1871: 242), apparently the voucher specimen labelled as Serbia, ex coll. O. Staudinger deposited in coll. MfN in Berlin was unknown to him. The literature data from Croatia (as Dalmatia or Yugoslavia) (Razowski 1987: 250, 313; 1970: 163; 2001: 37; 2002: 43, pl. 5 fig. 91, pl. 47 fig. 91; 2009: 37, pl. 9 fig. 97, pl. 40 fig. 97) and north-east Italy (Gradisca d'Isonzo, Monte Bondone) (Mann 1854: 576; Klimesch 1951: 24; Razowski 1970: 163; 2001: 37; 2002: 43; 2009: 37; Peter Huemer pers. comm.) refer to *C. callosana*, for details see below.

As a consequence, *C. perfusana* is replaced by *C. callosana* in the north-eastern Italian and Croatian fauna, and the former is regarded as requiring confirmation from the Czech Republic, north-western Italy and Slovenia. We consider the record from Ukraine (Crimea) (Razowski 1970: colour pl. 8 fig. 79-1) to be doubtful.

Taxonomic notes. *Argyrolepis perfusana* was described by Guenée (1845: 302) based on an unspecified number of specimens. Razowski (1970: 162), under *Stenodes perfusana*, states that the holotype, an undissected female labelled as “Type Guenée”, is deposited in NHMUK (Fig. 17), giving page 301 for Guenée’s description of *perfusana*, but later (Razowski 2002: 43; 2009: 37) he gives the correct page number (i.e., 302); however, all publications mention only the Austrian Alps as the type locality ignoring Dauphiné in France (see also below in discussion). In accordance with the ICZN article 74.6 Razowski’s (1970: 162) treatment of “Type Guenée” as the holotype must be considered a lectotype designation.

***Cochylimorpha dorsimaculana* (Preissecker, 1908), sp. rev.**

Figs 3, 4, 10, 14, 21–22, 29, 33, 38

Euxanthis dorsimaculana Preissecker, 1908, Verhandlungen der zoologisch-botanischen Gesellschaft in Wien 58: 70. Type locality: Wachau and Retz in Lower Austria. Synonymized with *Stenodes perfusana* (Guenée, 1845) by Razowski (1970: 162).

Euxanthis dorsimaculana Kennel 1913: 340, pl. 15 fig. 12.

Stenodes (Eustenodes) dorsimaculana Razowski 1960: 299, figs 14, 45, 70, 122.

Misidentifications. *Stenodes perfusana* Razowski 1970: colour pl. 8 fig. 79-2.

Cochylimorpha perfusana Razowski 2001: 36, colour pl. 3 fig. 51a; 2002: 43, colour pl. 5 fig. 91a; 2009: 37, colour pl. 3 fig. 97a.

Type material examined. *Euxanthis dorsimaculana* Preissecker, 1908: **Paralectotypes.** 1 ♂, [Lower Austria, Wachau,] Gaisberg, 9.vi.[19]07, Stein a.[n] D.[onau]; *dorsimaculana* Type; Praep. Gen. Nr.: 3427 ♂; *dorsimaculana* Pr., det. et praep.: J. Razowski, 1959, [museum-ID: MV 2143]; Preissecker l[eg.], NHMW (Fig. 34); 1 ♂, Gr.[osse] Heide, 2.vii.[19]05, Retz, Preissecker l[eg.], *dorsimaculana* Type; 1 ♂, Gaisberg, 9.vi.[19]07, Stein a.[n] D.[onau], Preissecker l[eg.], *dorsimaculana* Type, NHMW Type fot[o] 2013, NHMW, [left hindwing broken, abdomen missing]; 1 ♀, Gaisberg, 9.vi.[19]07, Stein a.[n] D.[onau], *Stenodes dorsimaculana* Type, Praep. Gen. Nr.: 3428 ♀/ Razowski, museum-ID: MV 2144, Preissecker l[eg.], *dorsimaculana* P., det. et praep.: 1959, J. Razowski, all NHMW.

Additional material examined. 6 ♂, 3 ♀, Austria: 1 ♂, Austr.[ia] inf.[erior], Retz, 17.vi.[19]11, genit. slide Buchner, museum-ID: MV 20072, Preissecker l[eg.], NHMW; 1 ♂, Austr.[ia] inf.[erior], Stein a.[n] D.[onau], Gaisberg, 1.vi.[19]14, Preissecker l[eg.], NHMW; 1 ♀, Austr.[ia] inf.[erior], Spitz, 2.vii.[19]22, genit. slide Buchner, museum-ID: MV 20076, NHMW; 1 ♂, Austria Inferior, Dürnstein, 1.vi.1962, J. Klimesch [leg.], [without abdomen], MfN; 2 ♂, 1 ♀: Lower Austria, Oberloiben, 300 m, larvae leg. 19.iv.2008 in flower-heads of *Centaurea triumfettii*, ♂♂ emerged 8. and 9.v.2008, ♀ emerged 10.v.2008, P. Buchner leg., cult. & coll.; 1 ♂, Lower Austria, Oberloiben, Höhereck, 300 m, 18.v.2011, DNA sample BC_LSNOE_02046 (658[0n]), W. Stark leg. & coll.; 1 ♀, Lower Austria, Retz, Muzion, 300 m, 7.vi.2014, DNA sample BC_LSNOE_02048 (658[0n]), W. Stark leg. & coll.

Diagnosis. *Cochylimorpha dorsimaculana* is externally characterized by a slightly yellowish white ground colour that differs only slightly from the light brownish yellow reticulate pattern; only the large yellowish brown dorsal blotch with an admixture of brown scales is distinct. In the male genitalia the tegumen has straight margins and a pointed terminal process; the valva is wide; the median process of the transtilla is rather short, very wide, and with a round apex; the caulis is wide with shallow ventro-lateral folds; and the phallus is long and S-shaped with a ventrally and laterally curved and latero-basally attached cornutus $\frac{1}{2}$ as long as the phallus. In the female genitalia the papillae anales are lanceolate and densely covered with strong short setae; the apophyses are stout; the ductus bursae is very short; and the corpus bursae is large with the signa posteriorly consisting of a small sclerotized plate with a few longitudinal folds and centrally a large group of thorns.

Redescription. Adult, male (Figs 3, 38). Head. Frons and vertex covered with brownish yellow scales. Labial palpus about 2.5 times diameter of eye, first segment short, second segment long and wide, third segment short, all covered with brownish yellow scales on the medial surface and yellowish brown on the lateral surface. Antenna filiform, reaching $\frac{1}{2}$ forewing length, brown, dorsally covered with brownish yellow scales.

Thorax. Dorsally covered with light brownish yellow scales similar to head, long and erect scales in posterior $\frac{1}{3}$. Tegula light brownish yellow. Forewing length 7–8 mm, wingspan 16–18.5 mm. Forewing short and trapezoidal, gradually widening from base to apex, about $2\frac{1}{3}$ times as long as wide, without costal fold, costal margin and termen straight, apex rounded. Ground colour shiny yellowish white differing only slightly in colour from the light brownish yellow reticulate pattern forming an indistinct basal blotch, a median transverse fascia and a subterminal blotch, distinct dorsal part of median transverse fascia a large, yellowish brown dorsal blotch. Admixture of brown scales forming an indistinct narrow line along basal $\frac{1}{2}$ of costal margin distally with small spots towards apex, distinct spots on edges of dorsal blotch and narrow oblique line on basal edge of subterminal blotch. Fringe yellowish white. Hindwing without costal roll, grey, darkest along margins, fringe slightly yellowish white with light grey basal line. Underside of thorax and forewing dark brownish grey, distal $\frac{1}{2}$ of costal margin with a row of light yellow spots, yellowish white line along basal $\frac{1}{2}$ of subcostal vein and along posterior margin, fringe yellowish white with an interrupted grey line; hindwing yellowish white densely covered with brownish grey scales in



Figure 38. *Euxanthia dorsimaculana* Preissecker, 1908, paralectotype ♂, slide and their labels, photograph P. Buchner, courtesy and with the kind permission of Sabine Gaal-Haszler, NHMW, Vienna.

anterior $\frac{1}{2}$, light yellow along M_2 vein, fringe yellowish white. Legs yellowish white with admixture of brownish grey scales on medial and lateral surfaces.

Abdomen covered with grey scales, light grey at distal edge of segments, and last segment with light brownish yellow scales.

Variation. Ground colour varying from almost pure white to yellowish white, markings and admixture of brown scales more or less pronounced.

Male genitalia (Figs 10, 21, 22, 29, 38). Tegumen tapering distally, with straight margins, terminal process short and pointed. Socius long, wide, trapezoidal, from lateral margin of tegumen, densely covered with medium long setae. Median process of transtilla rather short, very wide, parallel-sided, apex round, with a group of small thorns. Valva wide at base, gradually narrowing towards cucullus; costa only slightly convex at basal $\frac{1}{3}$, then straight towards cucullus; sacculus almost $\frac{1}{2}$ length of valva, convex; ventral margin of valva slightly convex; cucullus wide, round. Vinculum rod-like, slightly sinuous, parallel sided, ventral end curved inward; saccus short, membranous. Caulis wide with long, shallow ventro-lateral folds. Phallus as long as valva, S-shaped, coecum slightly curved dorsally, distally curved ventrally at about 15 degrees, ventral phallic process curved slightly more ventrally, rather long and tapering; vesica with single non-deciduous cornutus, stout, attached latero-basally, with a wide base, aciculate, slightly curved both ventrally and laterally, and only slightly shorter than $\frac{1}{2}$ length of phallus.

Variation. Cornutus variably curved, its base of varying size and shape.

Female (Fig. 4). Forewing length 7–8 mm, wingspan 16–18 mm. Forewing slightly wider than that of male. Hindwing with 3 bristles in the frenulum, nearly uniformly dark grey, fringe with distinct basal line.

Variation. Margins at end of hindwing veins with a row of dark grey dots.

Female genitalia (Figs 14, 33). Papilla analis $1\frac{1}{3}$ as long as segment VIII, narrow, elongated, lanceolate, densely covered with strong and short setae. Posterior apophysis almost 2 times as long as segment VIII, strongly sclerotized, posterior $\frac{1}{3}$ wide, rod-like and stout in remainder. Segment VIII with long, strong setae dispersed on posterior $\frac{1}{2}$. Anterior apophysis similar to posterior apophysis, but slightly longer. Ostium $\frac{1}{2}$ as wide as segment VIII. Antrum trapezoidal, strongly sclerotized, $\frac{2}{3}$ as long as wide. Sterigma with widened lateral sides and strengthened medially, densely covered with microspines. Anteostial sclerite weak, indistinct, flattened, with microspines. Ductus bursae membranous, as wide as antrum and slightly wider than long. Corpus bursae large, roundish, $1\frac{1}{2}$ as long as wide, membranous; signum a posteriorly situated, strongly sclerotized plate with distinct longitudinal folds and a group of large thorns arranged in a sinuous row extending from posterior $\frac{1}{3}$ into median $\frac{1}{3}$ of bursa. Accessory bursa membranous, about $\frac{1}{3}$ size of corpus bursae, with a short, wide postero-ventral join.

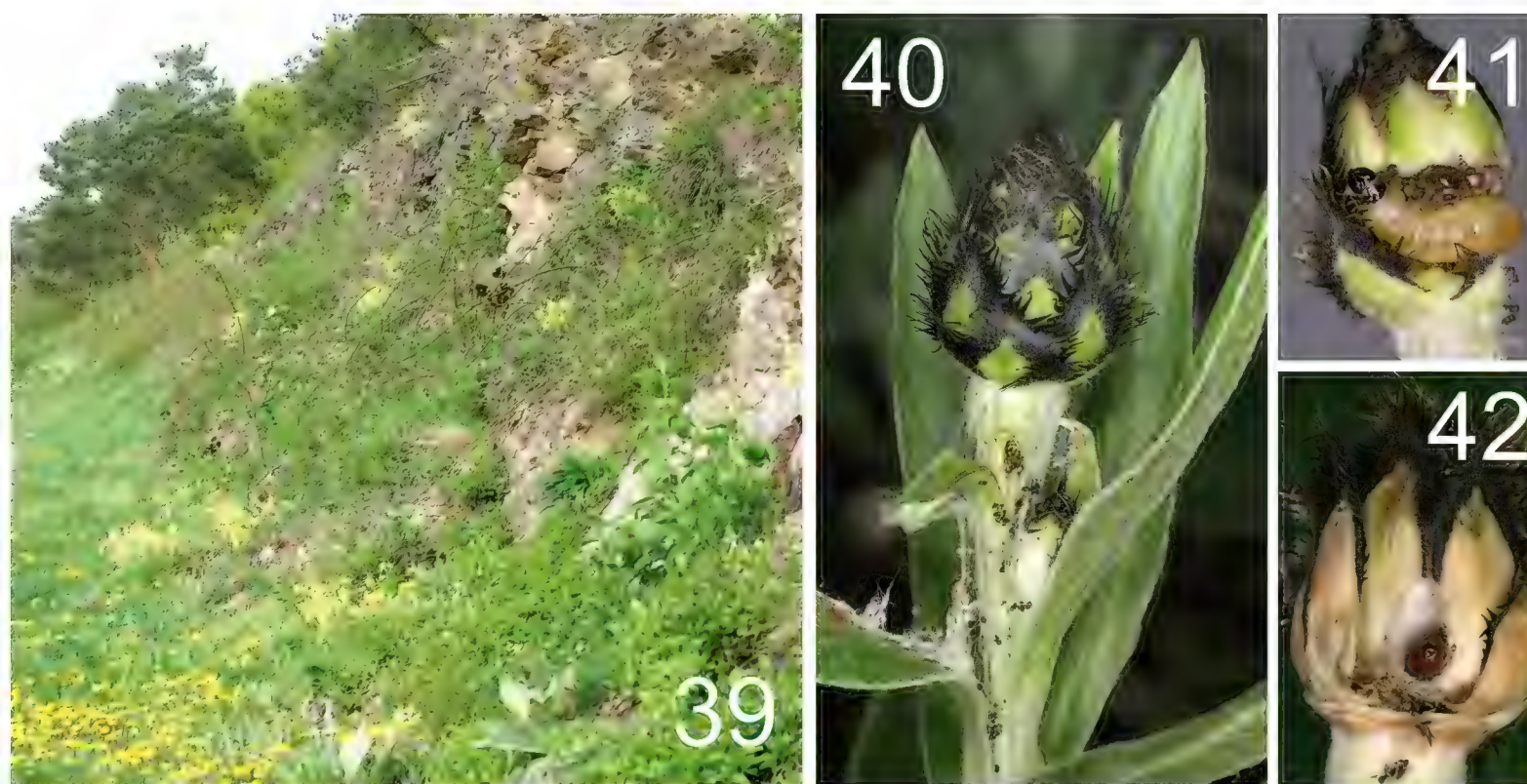
Molecular data (Fig. 36). BIN URI: BOLD:ADI4764. The intraspecific divergence of the barcode region is 0% ($n = 2$). The DNA barcoded specimens share the BIN with *C. perfusana*, but cluster separately as the sister group with a minimum distance of 1.07%. The minimum distance to *C. callosana* is 3.12%, and to *C. bucegiana* sp. nov. is 3.62%. *Cochylimorpha dorsimaculana* seems to be phylogenetically the most recently evolved member of the group.

Biology. In the original description the flight period was given as 27 May to 13 July, and *Centaurea rhenana* Bor. (= *Centaurea stoebe* L.) was identified as the presumed host-plant (Priessecker 1908: 72). Two ♂ and one ♀ from Oberloiben in the Wachau area were reared by P. Buchner in 2008. Larvae were found in the flower-heads of *Centaurea triumphettii* All. (Asteraceae) in mid-April, and pupated in the same place at the end of April (Figs 40–42). Adults emerged between 8–10 May, which is the earliest recorded date for the species. Given the restricted distribution of *C. dorsimaculana* and its confirmed host-plant, *Centaurea triumphettii*, it is doubtful that the widespread *Centaurea stoebe* is a host-plant.

Habitat (Fig. 39). Larvae have been collected in xerothermic open to semi-open habitats from *Centaurea triumphettii*, predominantly on south-east to south-west facing slopes at around 200–300 m elevation. These habitats are part of the Wachau, a 35 km long section of the river Danube, where it cuts through the southern tip of the Bohemian Massif. It therefore belongs to the southern edge of the Austrian natural area of granite and gneiss highlands.

Distribution (Fig. 48). *Cochylimorpha dorsimaculana* was described from the wine-growing area of Wachau and the neighbouring Retz in Lower Austria (Priessecker 1908: 72), and is only known from these two small areas of Lower Austria. All of the collecting sites are at low elevations between 200 and 300 m. The species is considered an endemic of Wachau and Retz in Lower Austria.

We examined material from Lower Austria: Wachau (Dürnstein, Gaisberg – type locality, Spitz an der Donau, Oberloiben) and Retz (Muzion); for details see the examined material above. Further material was identified from figures in the literature or available on the world wide web (all as *C. perfusana*): the same locations in the Wachau area and in Retz in Lower Austria (Razowski 1970: 162–163, pl. 8 fig. 79-2; 2001: pl. 3 fig. 51a; 2002: pl. 5 fig. 91a; 2009: pl. 3 fig. 97a; P. Buchner in Lepiforum; W. Stark in BOLD). Literature data: in Razowski (1970: 163, colour pl. 8 fig. 79-2; 2001: 37; 2002: 43; 2009: 37, all as *C. perfusana*) only records from Wachau and Retz in Lower Austria refer to this species. However, specimens from Hardegg, a similar habitat also in Lower Austria and also given by Razowski, may refer to this species, but we were not able to confirm this.



Figures 39–42. Habitat, host-plant and immature stages of *C. dorsimaculana* (Priessecker, 1908), sp. rev.: **39.** Habitat: Lower Austria, Oberloiben, 19.iv.2008; **40.** Attacked host-plant *Centaurea triumfettii* All.; **41.** Larva in flower-head of the host-plant; **42.** Pupa in flower-head of the host-plant; all same data as Fig. 39, but Fig. 42 photograph 27.iv.2008; photographs P. Buchner.

Remarks. We were not able to locate the voucher material of *Euxanthia dorsimaculana* Preiss. recorded from Romania (Transylvania) based on the written communication of J. Kennel given by Galvagni and Priessecker (1913: 49). Razowski’s (1970: 163) record from Romania (Transylvania) is based on the previous literature source. In our opinion these records may not refer to this species, but to *C. bucegiana* sp. nov.

Taxonomic notes. *Euxanthia dorsimaculana* was described from an unspecified number of specimens of both sexes collected from Wachau and Retz in Lower Austria (Priessecker 1908: 70). The lectotype ♂ (“Gaisberg, 10.VI.[19]06 Stein a.[n] D.[onau]” Coll. NHMW) was designated by Razowski (1970: 162) who synonymized the species with *Stenodes perfusana*. However, this specimen currently is untraceable in NHMW.

Razowski (1960: 299), in his description of the subgenus *Eustenodes* Razowski, 1960, designated *Euxanthia dorsimaculana* Priessecker, 1908 as the type species. Later this subgenus was synonymized with *Stenodes* Guenée, 1845 by Razowski (1970: 38, 116). The male genitalia of *C. dorsimaculana* were figured for the first time by P. Buchner (Lepiforum, accessed on 5 March 2024), the female genitalia are figured here for the first time.

The reasons why *Cochylimorpha dorsimaculana* (Priessecker, 1908), sp. rev. is elevated to species rank are:

- 1) the divergence in DNA barcodes: the DNA barcoded specimens of *C. dorsimaculana* and *C. perfusana* share the same BIN, but cluster in two sister groups with a minimum distance of 1.07% between them.
- 2) the strikingly different external morphology of the two taxa: *C. dorsimaculana* has an indistinct light brownish yellow reticulate pattern and the dominant element of the marking is a large,

brown dorsal blotch in contrast to a conspicuous light olive-green reticulate pattern uniformly dispersed on the entire forewing of *C. perfusana*.

- 3) the differences in the genitalia of both sexes. The male *C. dorsimaculana* has the tegumen with straight margins, a short and pointed terminal process, a rather short, very wide and parallel-sided median process of the transtilla with a round apex and a gradually narrowing valva, whereas *C. perfusana* has the tegumen with convex margins and an elongated terminal process, a long and wide median process of the transtilla with a tapering apex and a narrower and variable shaped valva. The female *C. dorsimaculana* possesses signa consisting of both a sclerotized plate and a group of thorns, whereas *C. perfusana* has a signum which is only a very weakly sclerotized plate.
- 4) the differences in habitats: *C. dorsimaculana* inhabits meadows at low elevations (200–300 m), in contrast to mountain and high-mountain meadows (between 550–2100 m) inhabited by *C. perfusana*.

***Cochylimorpha bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov.**

<https://zoobank.org/B2444CF8-A172-4EE1-91EC-D0523849BB11>

Figs 5, 6, 11, 15, 23, 24, 30, 34, 43–45

Misidentification. *Cochylimorpha perfusana* f. *callosana* (Herrich-Schäffer, 1851) Kovács and Kovács 2005: 61, 64 fig. 53, 70 fig. 72, 87, 88.

Type material. Holotype. Romania: ♂; Carpații Meridionali, Munții Bucegi, Valea Jepii; [45°24'30"N, 25°29'30"E]; 1800–2000 m; 1.viii.1999; S. Kovács & Z. Kovács leg. & coll. (Miercurea Ciuc) (Fig. 43).

Paratypes. 42 ♂, 3 ♀ (Figs 5, 6, 11, 15, 23, 24, 30, 34, 44, 45), Romania: 6 ♂; Carpații Meridionali, Munții Bucegi, Valea Jepii; 1800–1900 m; 10.viii.1986; genit. prep. Kovács 415, 425 and 1346; S. & Z. Kovács leg. & coll. 4 ♂, 1 ♀; Munții Bucegi, Valea Jepii; 1700–1800 m; 1.viii.1990; genit. prep. Kovács 2261/♀; S. & Z. Kovács leg. & coll. 7 ♂, 1 ♀; Munții Bucegi, Valea Jepii; 1800–2000 m; 1.viii.1999; DNA sample ♀ TLMF Lep 32673 [failed]; genit. slide Buchner w3567; S. & Z. Kovács leg. & coll. 2 ♂, 1 ♀; Munții Bucegi, Valea Jepii; 1800 m; 11.viii.2005; DNA sample ♀ TLMF Lep 27415 [failed], DNA sample ♂ TLMF Lep 28734 (685[0n]); genit. slide Buchner m3564; S. & Z. Kovács leg.; 1 ♀ TLMF; 2 ♂ S. Kovács & Z. Kovács coll. 2 ♂; Munții Bucegi, Valea Jepii; 1800 m; 9.vii.2013; DNA sample ♂ TLMF Lep 27416 [failed], DNA sample ♂ TLMF Lep 28750 (685[0n]); genit. slide Buchner m3565; S. & Z. Kovács leg.; 1 ♂ TLMF, 1 ♂ S. Kovács & Z. Kovács coll. 9 ♂; [județul] Prahova, Bușteni, [Munții Bucegi]; 20.viii.1989; genit. prep. Neumann 134, 154 and 296; H. Neumann leg.; MGAB. 1 ♂; M[un]t[ii] Bucegi, Valea Jepilor; 24.viii.1991; L. Székely leg.; MGAB 2218. 6 ♂; jud.[ețu]l Prahova, M-[un]ții Bucegi, Japi; alt[itudinea]: 1500–1700 m; 2.viii.1992; L. Székely leg.; MGAB 2218. 1 ♂; M[un]t[ii] Bucegi, Piatra Arsă; 2100 m; 31.vii.1993; L. Székely leg.; MGAB 2218. 3 ♂; M[un]t[ii] Bucegi, Vale[a] Japi; 1700 m; 1.viii.1993; L. Székely leg.; MGAB 2218. 1 ♂; M[un]t[ii] Făgăraș, Lac.[ul] Bîlea; 2200 m; 25.vii.1994; L. Székely leg.; MGAB 2218.

Diagnosis. *Cochylimorpha bucegiana* sp. nov. is externally characterised by a yellowish brown reticulate pattern that unites to form an indistinct basal blotch, a distinct median transverse fascia, subapical costal blotch, subterminal blotch, and slender terminal fascia that contrast with the shining yellowish white ground colour. In the male genitalia the tegumen has straight margins and an indistinct terminal process; the valva is long, with convex costal and ventral margins; the median process of the transtilla is wide, long, with slightly convex margins and a round apex; the phallus is stout, long, and curved ventrally at about 30 degrees; the ventral phallic process is long and



Figure 43. *Cochylimorpha bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov., holotype ♂ and labels, photograph P. Buchner.

tapering; and the cornutus is $\frac{1}{2}$ as long as the phallus, attached basally and laterally curved. In the female genitalia the papillae anales are wide, round and densely covered with medium-long and long setae; the apophyses are slender; the ductus bursae is short; the corpus bursae is narrow in the posterior $\frac{1}{4}$, then wide, roundish; the signum is in the form of a large sclerotized plate occupying most of corpus bursae, posteriorly with strongly sclerotized ribbon-like folds.

Description. Adult, male (Figs 5, 43, 44). Head. Frons and vertex covered with yellowish white scales. Labial palpus about 2.5 times diameter of eye, first segment short, second segment long and wide, third segment short, all covered with yellowish white scales on dorsal and medial, yellowish brown on lateral and ventral surfaces. Antenna filiform, $\frac{1}{2}$ forewing length, brown, covered with yellowish white scales dorsally.

Thorax. Dorsally covered with yellowish brown scales, long and erect in posterior $\frac{1}{3}$, laterally and tegula covered with light brownish yellow scales. Forewing length of holotype 7.5 mm, paratypes 6–8.5 mm, wingspan 14–19 mm. Forewing short and trapezoidal, gradually widening from base to apex, about $2\frac{2}{3}$ times as long as wide, costal margin slightly convex, without costal fold, apex pointed, termen straight. Ground colour shining yellowish white. Light yellowish brown reticulate pattern forming an indistinct basal blotch and distinct median transverse fascia, a subapical blotch, a weakly delimited subterminal blotch, and slender terminal fascia. Median transverse fascia perpendicular to costal margin, bent and parallel to termen immediately below costa, expanding towards middle of dorsal margin. Dense admixture of brown scales along basal $\frac{1}{3}$ of costal margin, on basal blotch, margins of median transverse fascia and subapical blotch. Fringe shining yellowish white. Hindwing without costal roll, brownish grey, fringe shining yellowish white with grey basal line. Underside of thorax and forewing dark brownish grey, indistinct yellowish white line along median $\frac{1}{3}$ of subcostal vein, fringe yellowish white, hindwing grey, fringe yellowish white. Legs covered with brownish grey scales on medial and yellowish white on lateral surface.

Abdomen covered with dark grey scales, distal edge of segments and last segment with yellowish white scales.

Variation. Forewing is variable, sometimes much lighter, median fascia may be interrupted below costa, subapical blotch less pronounced, subterminal blotch indistinct, terminal fascia fragmented, forming a row of terminal dots, hindwing yellowish grey.



Figures 44, 45. Details of the adult of *Cochylimorpha bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov., paratypes: **44.** ♂, head and labial palpus in left infero-lateral view, same data as Fig. 5; **45.** ♀, head, thorax and abdomen in left supero-lateral view, same data as Fig. 6; photographs P. Buchner.

Male genitalia (Figs 11, 23, 24, 30). Tegumen tapering, with straight margins, terminal process indistinct. Socius long, triangular, from margin of tegumen, with sclerotized apex, densely covered with medium-long setae. Median process of transtilla long, with slightly convex margins, round apically with group of small thorns. Valva wide, elongated, costa slightly convex in basal $\frac{1}{2}$, slightly sclerotized sacculus not reaching middle of valva, ventral margin of valva convex, distally evenly curved, cucullus round. Vinculum rod-like, wide, strengthened end inwardly curved; saccus membranous. Caulis with long and shallow ventro-lateral folds. Phallus slightly shorter than valva, stout, widest at coecum, distal end ventrally curved at about 30 degrees, ventral phallic process long and evenly tapering. Vesica with single non-deciduous cornutus stout, basally attached with a round base, aciculate, laterally curved, evenly tapering, and $\frac{1}{2}$ as long as phallus.

Variation. Terminal process sometimes truncated; basal half of costa of valva varies from slightly to fairly convex.

Female (Figs 6, 45). Forewing length 7.5–8 mm, wingspan 16.5–17 mm. Forewing markings slightly more extended and with a more pronounced admixture of brown scales than in male. Hindwing with 3 bristles in the frenulum.

Female genitalia (Figs 15, 34). Papilla analis 2 times as long as segment VIII, wide, roundish, densely covered with medium-long and long setae. Posterior apophysis almost 2 times as long as segment VIII, rod-like, strongly sclerotized, slender. Posterior part of segment VIII covered with strong and long setae, with a row of small setae along anterior margin. Anterior apophysis as long as posterior, rod-like, strongly sclerotized and slender. Antrum as wide as segment VIII. Sterigma with wide and strongly sclerotized lateral sides and weakly sclerotized strengthened medially and densely covered with small microspines. Anteostial sclerite large, distinct and densely covered with microspines. Ostium $\frac{1}{2}$ as wide as segment VIII. Ductus bursae $\frac{1}{2}$ width of ostium, short, membranous. Corpus bursae narrow at posterior $\frac{1}{4}$, slightly narrower than half of segment VIII, anterior $\frac{3}{4}$ wide, roundish, slightly wider than segment VIII; signum a large sclerotized plate occupying posterior $\frac{4}{5}$ of corpus bursae, posteriorly with strongly sclerotized ribbon-like folds, only a small anterior part of corpus bursae membranous. Accessory bursa membranous, longer than corpus bursae, more than 2 times as long as wide, with long and narrow postero-ventral join and about $\frac{1}{2}$ of the size of corpus bursae.

Variation. Size of sclerotized plate variable from $\frac{2}{3}$ to $\frac{4}{5}$ of the corpus bursae.

Molecular data (Fig. 36). BIN URI: BOLD:AEH6249. The intraspecific divergence of the DNA barcode region is 0% ($n = 2$). The minimum distance to the nearest neighbour, *C. dorsimaculana*, is 3.62%. The minimum distance to *C. perfusana* is 3.73% and to *C. callosana* 4.43%.

Habitat (Fig. 46). The new species inhabits high-mountain to subalpine mesophilic meadows with straggling *Larix decidua* Mill. (Pinaceae) trees on south-east facing steep slopes on conglomerate substrate in the Bucegi Mountains and subalpine mesophilic meadows on silicate substrate in the Făgăraș Mountains, at 1500–2200 m altitude, where its presumed host-plant, *Centaurea kotschyana* Heuff. (Asteraceae) is abundant.

Biology. Poorly known, adults were collected from mid-July to the end of August.

Distribution. Only known from Romania, Southern Carpathians: Bucegi Mountains (Jepii valley – type locality; Piatra Arsă) and the Făgăraș Mountains (environs of the Bâlea Lake) at 1500–2200 m elevation (Fig. 48). Possibly a Southern Carpathian endemic. However, the range of its presumed host-plant, *Centaurea kotschyana*, is much wider, occurring scattered localities throughout the high-mountain and subalpine zone of the Carpathians, from Poland and Ukraine through the Romanian Eastern and Southern Carpathians, the Apuseni Mountains to the mountains of the Balkan Peninsula (Stara Planina) (Prodan 1930; A. Bartók pers. comm. 2024), suggesting a wider distribution of the moth as well.

Remarks. A record by Kovács and Kovács (2005: 61, 64 fig. 53, 70 fig. 72, 87, 88) from the Bucegi Mountains under the name *Cochylimorpha perfusana* f. *callosana* (Herrich-Schäffer, 1851) was based on the above mentioned examined material and refers to this species. We were not able to locate the voucher material of *Euxanthia dorsimaculana* Preiss. recorded from Romania (Transylvania) based on the written communication of J. Kennel by Galvagni and Preisser (1913: 49). Razowski's (1970: 163) record from Romania (Transylvania) is based on the previous literature source. In our opinion, these records may not refer to *C. dorsimaculana*, but to this species.

Etymology. The specific name is a feminine adjective derived from the name of the type locality, the Bucegi Mountains.

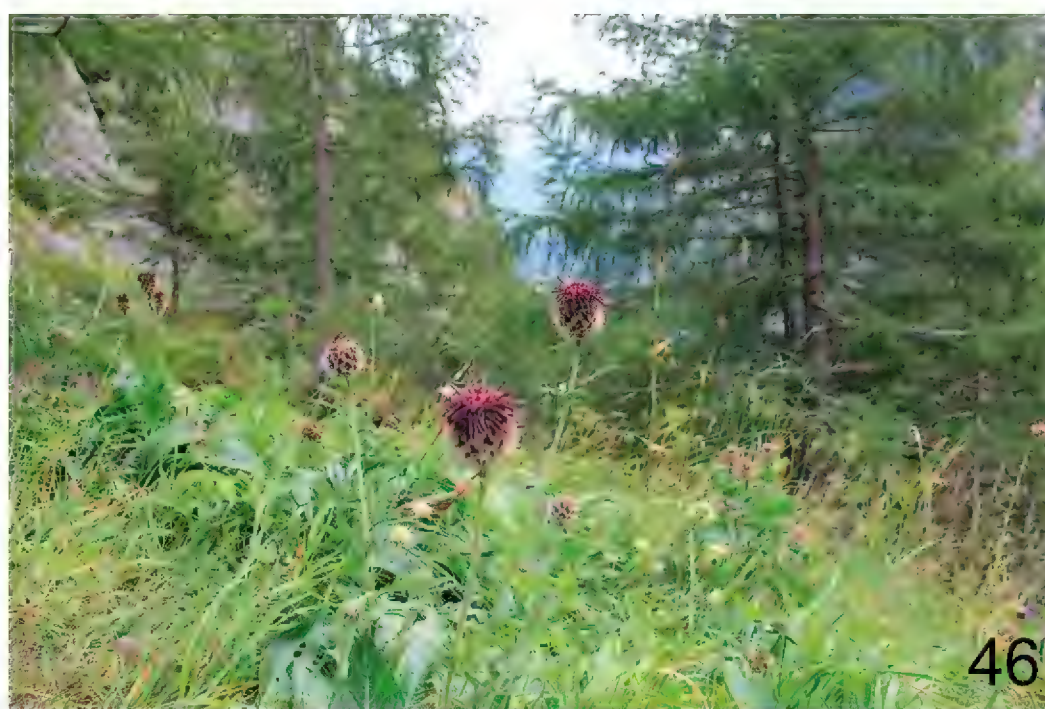


Figure 46. Habitat of *Cochylimorpha bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov.: Romania, Southern Carpathians, Bucegi Mountains, Jepii valley, 1900 m, 15.viii.2023, in the foreground the presumed host-plant *Centaurea kotschyana* Heuff., photograph S. Kovács.

***Cochylimorpha callosana* (Herrich-Schäffer, 1856), sp. rev.**

Figs 7, 8, 12, 16, 25–27, 31, 35, 47

Cochylis callosana Herrich-Schäffer, 1856, Systematische Bearbeitung der Schmetterlinge von Europa 6: 157. Type locality: Fiume, currently Rijeka in Croatia. Synonymized with *Stenodes perfusana* (Guenée, 1845) by Razowski (1970: 38).

Cochylis Callosana Mihi. Mann 1854: 576 – nomen nudum.

Cochylis Callosana Mann i. l. H. S. Mann 1855: 552 – nomen nudum.

Phalonis callosana HS Kennel 1913: 283, pl. 12 fig. 85.

Euxanthia callosana HS Klimesch 1951: 24.

Stenodes perfusana (Guen.) Razowski 1987: 250 figs 70–72, 313 figs 562–563.

Cochylimorpha perfusana (Guenée, 1845) Razowski 2001: 111 pl. 8 fig. 51, 186 pl. 83 fig. 51; 2002: pl. 10 fig. 91, pl. 47 fig. 91; 2009: 138 pl. 9 fig. 97, 169 pl. 40 fig. 97.

Erroneous treatments. Razowski (1970: 38, 162) as *Cochylis callosana* Herrich-Schäffer, 1851 – unjustified synonymy with *Stenodes perfusana* (Guenée, 1845), incorrect year of description, incorrect type locality (specified as “Locus typicus: Niederösterreich: Schneeberg”).

Misidentification. *Phalonidia acutana* (Kennel, 1913) R. Bryner in Lepiforum – adult female and female genitalia.

Type material examined. *Cochylis callosana* Herrich-Schäffer, 1856: **Lectotype.** ♂, Callosana HS.; H. – Sch.; Origin. [al]; loc. ?; ex coll. Staudinger 1/2; Zool. Mus. Berlin; MfN URI <http://coll.mfn-berlin.de/u/09f9e3>; MfN (Fig. 47). The images of the lectotype from the MfN are figured here courtesy and kind permission of Viola Richter.

Paralectotype. ♂, Callosana HS.; H. – Sch.; Origin. [al]; loc. ?; ex coll. Staudinger 2/2; Zool. Mus. Berlin; MfN URI <http://coll.mfn-berlin.de/u/09fb0a>; MfN.

Additional examined material. 35 ♂, 8 ♀, Croatia: 1 ♀, Fiume, Krone [leg.], Sammlung [= collection] Disque, DNA sample ZSM_46193_A06 [failed], ZSM; 1 ♀, Fium[e], 13.vi.[1]853, NHMW; 1 ♂, Fiume, 1853, prep. slide 3589 ♂/ Razowski 1959, museum-ID: MV 2117, NHMW; 1 ♂, Fiume, 1853, genit. slide Buchner, museum-ID: MV 20073, NHMW; 1 ♂, M[on]t[e] Maggiore, 12.vi.[19]08, *callos*.[ana], NHMW; 15 ♂, 2 ♀, Velebitski, 700 m, 5.vi.2008, genit. slide Junnilainen 201711 ♂, 201722 ♀, genit. prep. Junnilainen 2 ♂ in glycerol, genit. slide Buchner m3566, DNA sample ♂ 25903 Lepid Phyl (658[0n]), J. Junnilainen leg. & coll; 1 ♂, Central Velebit, Baške Oštarije, 1100 m, 4–5.vi.2015, J. Junnilainen leg. & coll; France: 1 specimen, Corsica, ex coll. Staudinger, MfN; 1 specimen, Corsica, [18]55, [without abdomen], ex coll. A. Caradja, MGAB 118233; Hungary: 1 ♂, 1 ♀, Budapest, Jambory [= Csillebérc], Sammlung [= collection] Disque, [genitalia] prep. No. M 788, “*Cochylis*” *callosana* HS ♂, N. Obratsov det. 1950, *Cochylimorpha perfusana* Guenée, det. Fazekas '[19]94, DNA sample ♀ ZSM_46193_A03 (145[1n]), ZSM; Italy: 1 ♀, Triest[e], Palisa, prep. genit. 3590 ♀/ Razowski 1959 *Aethes callosana*, museum-ID: MV 2118, NHMW; 1 ♂, Raibl [Udine], 1869, *Stenodes callosana* Gn., det. J. Razowski, NHMW; 1 ♂, Friaul, Gemona, 18.vi.[19]50, [ex] coll. Thurner, DNA sample ZSM_46193_A04 [failed], ZSM; 2 ♂, Friaul, L[a]go Cavazzo, 28.v.[19]52, [ex] coll. Thurner, DNA sample ZSM_46193_A05 [failed], ZSM; Slovenia: 1 ♂, Carniolia, Nanos, 19.vi.[19]09, NHMW; 2 ♂, Kozina, 400 m, 30.v.2008, J. Junnilainen leg. & coll; 1 ♀, Senožeče, 500 m, 30.v.2008, genit. prep. Junnilainen in glycerol, slide Buchner w3568, DNA sample TLMF Lep 32487 (658[0n]), J. Junnilainen leg. & coll; 2 ♂, Senožeče, 500 m, 31.v.2008, genit. prep. Junnilainen in glycerol, J. Junnilainen leg. & coll; 3 ♂, 1 ♀, Komen, 500 m, 31.v.2008, J. Junnilainen leg. & coll.; No locality data: 1 specimen, *Euxanthia callosana*, G.S. 7574 ♀, *Stenodes callosana* HS., det. J. Razowski, ex coll. A. Caradja, MGAB 118233.

Diagnosis. *Cochylimorpha callosana* is externally characterized by an extensive and conspicuous straw-yellow reticulate pattern with a scattered admixture of brown scales, and yellowish white spots of ground colour which are indistinct and of irregular size and form. In the



Figure 47. *Cochylis callosana* Herrich-Schäffer, 1856, lectotype ♂ and its labels, courtesy and kind permission of Viola Richter, MfN, Berlin.

male genitalia the tegumen has convex margins and a long terminal process; the valva is wide; the median process of the transtilla is long and wide with concave margins and a truncated apex; the caulis has deep ventro-lateral folds; and the phallus is ventrally curved at about 30 degrees with a latero-basally attached and ventrally curved cornutus, about $\frac{1}{2}$ as long as the phallus. In the female genitalia the papillae anales are lanceolate and densely covered with short setae; the apophyses are stout; the ductus bursae is short; and the corpus bursae is long with the signa posteriorly consisting of a large sclerotized plate and in the median part of the bursa with a large group of thorns.

Redescription. Adult, male (Figs 7, 47). Head. Frons and vertex covered with straw-yellow scales. Labial palpus about 2.5 times diameter of eye, first segment short, second segment long and wide, third segment short, all segments with straw-yellow scales on medial surface, brownish yellow on lateral surface. Antenna filiform, reaching $\frac{1}{2}$ forewing, brown, covered with straw-yellow scales dorsally.

Thorax. Dorsally covered with straw-yellow scales, long and erect in posterior $\frac{1}{3}$. Tegula covered with straw-yellow scales. Forewing length 7–8.5 mm, wingspan 15.5–19 mm. Forewing short and trapezoidal, slightly widening from base to apex, about $2\frac{1}{4}$ times as long as wide, costal margin without costal fold, convex in basal $\frac{1}{3}$, remainder straight, apex rounded, termen straight. Shiny yellowish white spots of ground colour larger and irregularly shaped basally, smaller and roundish apically. Reticulate pattern consisting of numerous wide, sinuous, straw-yellow cross-lines, often forming a narrow, elongated and indistinct dorsal blotch. Scattered admixture of brown scales forming small indistinct spots along costal margin and middle of dorsal margin, dense and consisting of scattered spots on median and subterminal areas, and only dispersed brown scales along termen and apex. Fringe shiny yellowish white. Hindwing without costal roll, dark grey, fringe white with grey basal line. Underside of thorax and forewing brownish grey, yellow along distal $\frac{1}{2}$ of the costal margin and along basal $\frac{1}{2}$ of subcostal vein, fringe yellowish white, with grey basal line, hindwing yellowish white with admixture of grey scales, yellow along M_2 vein, fringe yellowish white with indistinct grey basal line. Fore- and mid-leg covered with brownish-grey scales on medial and yellowish white on lateral surface, hindleg ochreous white.

Abdomen. Covered with grey scales, light grey at distal edge of segments, and last segment with yellowish white scales.

Variation. Colour of markings varying from straw-yellow to light brownish yellow; narrow and indistinct dorsal blotch often light brownish yellow. In fresh specimens straw-yellow reticulate pattern dominates.

Male genitalia (Figs 12, 25–27, 31). Tegumen tapering, with convex margins and long terminal process. Socius long, broadly rounded from margin of tegumen, densely covered with medium-long setae. Median process of transtilla wide, with concave margins, distal 1/4 round, truncated apically with group of small thorns. Valva wide, elongated, costa concave with evident swelling in basal 1/2, sacculus 2/5 length of valva, ventral margin of valva straight, cucullus widely rounded. Vinculum rod-like, straight, dorsal 1/2 slender, ventral 1/2 slightly wider, ventral end inwardly curved, saccus membranous. Caulis wide with long and deep ventro-lateral folds. Phallus shorter than valva, curved ventrally about 30 degrees at 1/2 of its length, ventral phallic process short, tapering. Vesica with a single stout, latero-basally attached, non-deciduous cornutus, with a broadly round base, aciculate, slightly ventrally curved, and 1/2 as long as phallus.

Variation. Terminal process of tegumen variable, more or less pointed; median process of transtilla more or less strengthened medially, small thorns at apex arranged in two parallel rows.

Female (Fig. 8). Forewing length 6–7.5 mm, wingspan 14–16.5 mm. Forewing markings more conspicuous, admixture of brown scales less pronounced and ill-defined spots of ground colour smaller than in male. Hindwing with 3 bristles in the frenulum.

Female genitalia (Figs 16, 35). Papilla analis 1 1/2 as long as segment VIII, narrow, elongated, lanceolate, densely covered with strong, short setae. Posterior apophysis 1 1/2 as long as segment VIII, posterior 1/3 wide and weakly sclerotized, anterior 2/3 rod-like, stout and strongly sclerotized. Segment VIII slightly longer than wide, dorsally with 2 rows of strong and long setae along posterior margin, ventrally with a single row along margins. Anterior apophysis slightly shorter than posterior apophysis, entirely rod-like, stout and strongly sclerotized. Sterigma with wide lateral sides and strengthened middle covered with weak microspines. Anteostial sclerite small, covered with weak microspines. Ostium almost as wide as segment VIII. Antrum 1/2 as long as wide, strongly sclerotized. Ductus bursae 1/2 as wide as ostium, shorter than wide, membranous. Corpus bursae about 2 times as long as wide, rounded anteriorly, membranous; posterior 1/2 occupied by signa consisting of a large sclerotized plate posteriorly with weak longitudinal folds; in middle of corpus bursae a large group of tiny thorns. Accessory bursa membranous, almost 1/2 of size of corpus bursae, with a short and wide postero-lateral join.

Molecular data (Fig. 36). BIN URI: BOLD:ADI3050. The intraspecific divergence of the DNA barcode region is 0.15% (n = 2). The minimum distance to the nearest neighbour, *C. dorsimaculana*, is 3.12%, to *C. perfusana* 3.13%, to *C. bucegiana* sp. nov. 4.43%.

Habitat. Dry and stony open hilly meadows and semi-open mountain slopes on limestone substrate, from 350 to 1500 m.

Biology. Poorly known. Adults fly in the daytime (Mann 1854: 576) and evening (Mann 1857: 165). The most recently collected specimens were taken in the evening and early morning by net, usually around places where *Centaurea* (Asteraceae) species grow, but some specimens were also attracted to light (J. Junnilainen personal observation). Moths are on wing from mid-May to mid-June.

Distribution (Fig. 48). Widespread in the north-western part of the Balkan Peninsula (Croatia and Slovenia) and north-eastern Italy, localized in eastern France (Prémanon), and known only from historic records from Corsica (France) and Hungary. The type locality is Rijeka (formerly

Fiume) in north-western Croatia (Herrich-Schäffer 1856: 157). Razowski (1970: 162; 2002: 43; 2009: 37) erroneously gives Lower Austria: Schneeberg or only Austria as the type locality of the species, but these records refer to *C. perfusana* (Herrich-Schäffer 1851: 183).

We examined voucher material from north-western Croatia (Rijeka; Velebit Mountains: Velebitski, Baške Oštarije, 1100 m; Istria: Mt. Maggiore), south-western Slovenia (Nanos; Senožeče; Kozina; Komen), north-eastern Italy (Trieste; Trentino; Friuli; Udine), Corsica and Hungary (Budapest, Csillebérc, as Jambory). These are the first country records for Slovenia and Hungary (for explanations see below). Further material was identified from figures in the literature or available on the world wide web (all as *C. perfusana* unless otherwise mentioned): Yugoslavia without further details (Razowski 1987: 250 figs 70–72, 313 figs 562–563 as *Stenodes perfusana*; 2001: 37; 2002: 43, pl. 5 fig. 91, pl. 47 fig. 91; 2009: 37, pl. 9 fig. 97, pl. 40 fig. 97); north-eastern Italy (Monte Bondone, Viotte, 1500 m; Val. Venzonassa, Malga Confin; Trieste, Basovizza, 440 m) (Klimesch 1951: 24; P. Huemer in BOLD and pers. comm.; R. Bryner in Lepiforum as *Phalonidia acutana* (Kennel, 1913)); Hungary (Budapest) (Fazekas 1994: 40 fig. 1); and the first record from mainland France (Prémanon, 26.v.2022) (G. Mainguy in iNaturalist).

Literature records. The earliest record of the species, which predates Herrich-Schäffer's (1856: 157) formal description, is from Gradischa in the historic southern Carniolia (= Krain in German) by Mann (1854: 576 as *Cochylis Callosana* Mihi. [probably Mtzn., error during digitalization]). This historic locality name currently is known as Gradisca d'Isonzo in the north-eastern part of modern Italy. Another record, which also predates the formal description, is given by Mann (1855: 552 as *Cochylis Callosana* Mann i. l. H. S.) from Corsica (Lazareth peak on the road from Ajaccio to Tavaco). There are two historic voucher specimens labelled as Corsica, one in ex coll. O. Staudinger in

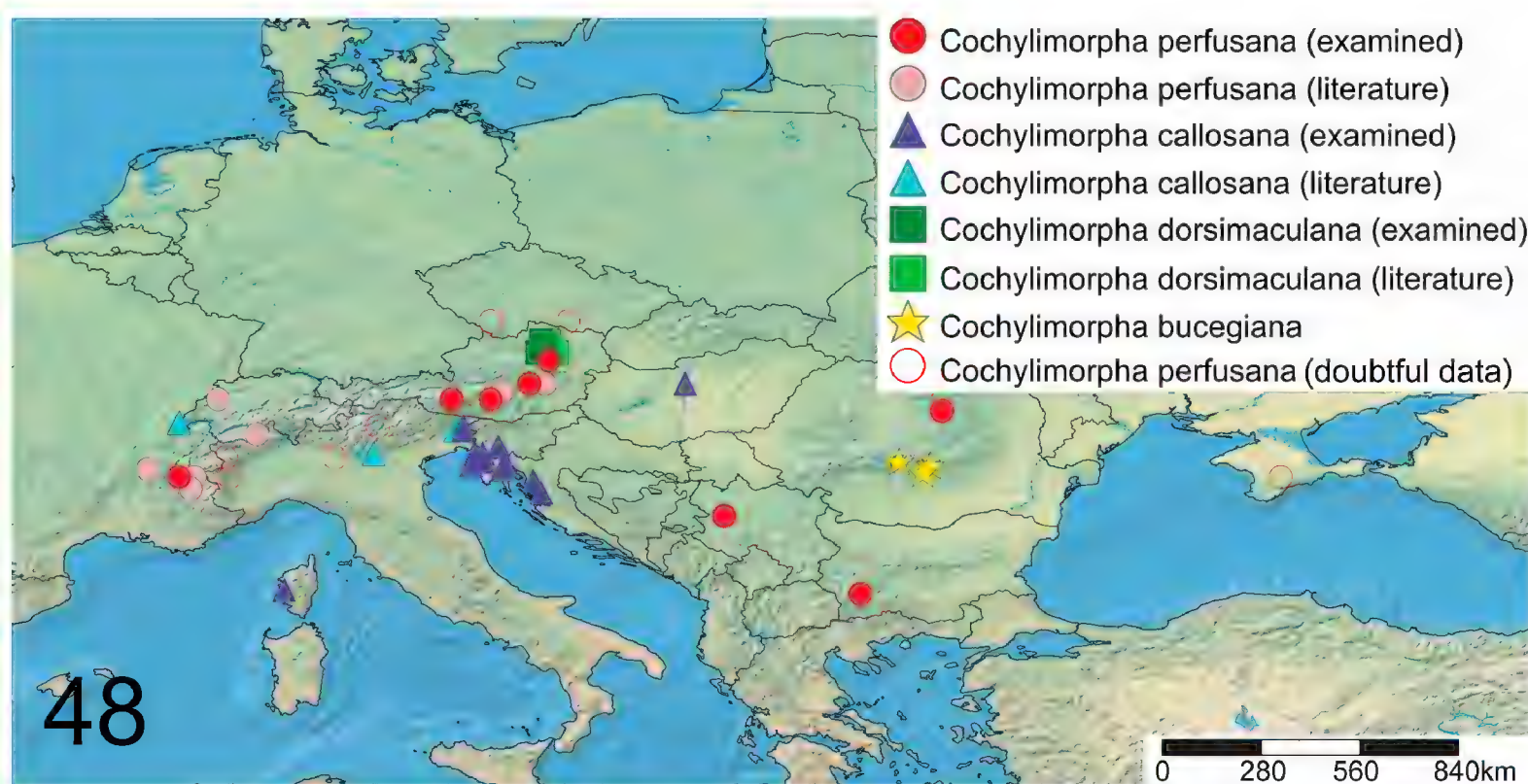


Figure 48. Distribution map of the *Cochylimorpha perfusana* species group based on material examined (dark shades), literature sources (light shades) and doubtful literature data (open circles): *C. perfusana* (Guenée, 1845) red circles; *C. dorsimaculana* (Preissecker, 1908), sp. rev. green squares; *C. bucegiana* Z. Kovács, S. Kovács & P. Buchner, sp. nov. yellow stars; *C. callosana* (Herrich-Schäffer, 1856), sp. rev. blue triangles. Map created with SimpleMappr (<http://www.simplemappr.net>).

MfN, Berlin (Viola Richter pers. comm.) and another in ex coll. A. Caradja in MGAB, Bucharest (M. Stănescu pers. comm.). Molecular studies of recently collected material from Corsica will be necessary for the certain identification. Mann (1857: 165) recorded it from Fiume (= Rijeka) in Croatia. According to Staudinger and Wocke (1871: 242), the species is distributed in southern Carniolia and Corsica (France), both repetitions of the data of Mann (1854: 576; 1855: 552). Kennel (1913: 284) mentions Corsica (France), southern Carniolia, Istria, Dalmatia (Croatia) and Wallis (Switzerland). The first two are repetitions of the previous references. We examined voucher material from Croatia, but we cannot confirm the record from Wallis because the studied figures of adults from Switzerland posted on different websites all proved to be *C. perfusana* (see above).

Klimesch (1951: 24) recorded it as *Euxanthia callosana* HS. from Italy, Trentino, Monte Bol-done, Viotte, 1500 m, this is the highest recorded elevation for the species. It has been reported from Hungary by Gozmány (1968: 277 as *Stenodes callosana* HS) without further data. Subsequently, two historic specimens collected from Budapest (Jambory = Csillebérc, Zs. Bálint pers. comm.) and deposited in ZSM were recorded as *C. perfusana* by Fazekas (1994: 40). Later the species was also mentioned in the checklists as *C. perfusana*, from the first (Szabóky *et al.* 2002: 68) to the latest (Pastoralis and Buschmann 2018: 135), but recently the two historic specimens deposited in ZSM have been ignored, and the species deleted from the Hungarian checklist by Fazekas (2022: 118; 2023: 24, 28). In Razowski's works (1970: 163; 2001: 37; 2002: 43; 2009: 37, all as *C. perfusana*) only records from Italy and Croatia (Dalmatia) are of *C. callosana*. Trematerra (2003: 51) recorded *C. perfusana* from northern Italy, but the data from north-eastern Italy (Friuli-Venezia Giulia) refer to this species, the other records need re-examination (for details see *C. perfusana* above). The record of *C. perfusana* f. *callosana* from Romania (Bucegi Mountains) by Kovács and Kovács (2005: 61, 64 fig. 53, 70 fig. 72, 87, 88) was erroneous and is of *C. bucegiensis* sp. nov. Lesar and Godevič (2010: 77) list *C. perfusana* from Slovenia based only on two old literature sources, Mann (1854) and Staudinger and Wocke (1871), however, as we already demonstrated above, all these historic records under the name *C. callosana* refer to modern Italy. The latter authors mention also *C. perfusana*, but from Serbia. As a consequence, all of these data for *C. perfusana* and *C. callosana* are not part of the Slovenian fauna. Glerean *et al.* (2022: 60 as *C. perfusana*) published data from the Prealpi Giulie Natural Park (Gruppo del Monte Plauris) in Friuli, north-east Italy. We were not able to examine the voucher specimens, but we presume that the record may refer to *C. callosana*, because all of the specimens examined from north-eastern Italy proved to belong to the latter species.

As a consequence, confirmed data of *C. callosana* are recorded herewithin for the first time from the Slovenian fauna as the previous records refer to Italy. The species also replaces *C. perfusana* in north-eastern Italy, and the records from north-western Italy require re-examination (Trematerra 2003: 51; Stoch 2003). We report *C. callosana* again from Hungary as recently Fazekas (2022: 118; 2023: 24, 28 all as *C. perfusana*) deleted it from the checklist, claiming lack of evidence.

Taxonomic notes. *Cochylis callosana* was described based on an unspecified number of specimens from Fiume (currently Rijeka in Croatia) by Herrich-Schäffer (1856: 157) in the sixth volume of his Systematische Bearbeitung der Schmetterlinge von Europa as a species related to *C. perfusana* (“Der *Perfusana* am nächsten,...”), the latter species was mentioned in the fourth volume (Herrich-Schäffer 1851: 183). Also in the sixth volume, but in the Index of the fourth volume, both species were mentioned and both cross-referenced to the same page: “**callosana* (*Cochylis*) Mtn. pp.183” and “***perfusana* (*Cochylis*) FR. p. 183, HS 247, 248” (Herrich-Schäffer 1856: Index 7, 32). These similar references have probably been the starting point of the subsequent confusion and taxonomic problems, because at the specified page, 183, there is only the description of *C. perfusana*.

Two arguments support our presumption that the name *C. callosana* might be a commonly used manuscript name before the Herrich-Schäffer's formal description. In the Index of the fourth volume, Herrich-Schäffer (1856: 7) mentions "Mtzn." (= Metzner) as the author of the species name, and the second is that Mann (1854: 576; 1855: 552) twice used the name *callosana* to record a well-defined moth from southern Carniolia and Corsica before the description of the species by Herrich-Schäffer (1856: 157). *Cochylis callosana* was defined by Herrich-Schäffer (1856: 157) as having a short forewing, straw-yellow coloured markings with only two black spots on the forewing, neither on costal margin nor on termen (remarks: the black spots are the scattered spots formed by the admixture of brown scales). All these characters fit the material examined in this study from Croatia, Slovenia, Italy, France and Hungary. It has also been treated as a valid species, *Phalonia callosana* HS., by Kennel (1913: 283–284, pl. 12 fig. 85). Kennel's description also fits the original one, except for the figure which, as mentioned by Kennel himself, is too light yellow ("Taf. XII, fig. 85 ♂ (zu hochgelb)") (Kennel 1913: 283); however, this feature characterizes worn specimens. This species has also been treated by Klimesch (1951: 24) as *Euxanthia callosana* HS. In the monograph on the Palearctic Cochylini, Razowski (1970: 38, 162, colour pl. 8, pl. 50, pl. 127) mentions a lectotype deposited in MfN Berlin, but incorrectly gives Schneeberg in Lower Austria as the type locality. Neither the lectotype nor the paralectotype possesses locality data. Razowski confused and synonymized *C. callosana* with *C. perfusana*, and gave the reference as: "*Cochylis callosana* Herrich-Schäffer, 1851, Systematische Bearbeitung der Schmetterlinge von Europa 4: 183", however, this is wrong and in fact it refers to *C. perfusana*. The correct reference is: *Cochylis callosana* Herrich-Schäffer, 1856, Systematische Bearbeitung der Schmetterlinge von Europa 6: 157 (different year, volume and page), where Fiume (= Rijeka, Croatia) is specified as the type locality. Razowski figured two male adults, one of *C. perfusana* and another of *C. dorsimaculana* (as *perfusana* f. *dorsimaculana*), and the genitalia of both sexes of *C. perfusana*. In his subsequent works Razowski (2001: 13; 2002: 43; 2009: 37) continues using the incorrect data and taxonomic status, and figures the adult male of *C. perfusana*, the female of *C. dorsimaculana*, and the genitalia of both sexes of *C. callosana*, all under the name *C. perfusana*.

The reasons why *Cochylimorpha callosana* (Herrich-Schäffer, 1856), sp. rev. is reinstated to species rank are:

- 1) the divergence in the DNA barcodes: the DNA barcoded specimens cluster in a separate BIN (BOLD:ADI3050), at a minimum distance of 3.12% to the nearest neighbour *C. dorsimaculana*, at 3.13% to *C. perfusana* and 4.43% to *C. bucegiana* sp. nov.
- 2) the different external morphology: straw-yellow reticulate pattern with scattered admixture of brown scales and grey hindwing characterizes *C. callosana*, in contrast to the olive-green reticulate pattern without an admixture of brown scales and the light grey hindwing of *C. perfusana*.
- 3) the clear differences in the structure of the genitalia of both sexes: the male with slightly concave margins and truncated apex of the median process of the transtilla and ventrally curved phallus of *C. callosana*, in contrast to *C. perfusana* male with a parallel sided and tapering apex of the median process of the transtilla and straight phallus; and female with a long corpus bursae and signa consisting of a large sclerotized plate posteriorly with weak longitudinal folds and in the middle of bursa a large group of tiny thorns of *C. callosana*, in contrast to *C. perfusana* female with a short corpus bursae and the signum being a very weakly sclerotized plate in the posterior 1/3 of the bursa, with distinct longitudinal folds.
- 4) the clear differences in the habitat and distributional pattern: *C. callosana* inhabits meadows at lower elevations (from 350–1500 m) and is widespread only in the north-western Balkan

Peninsula and north-eastern Italy, and is local in eastern France, Corsica and Hungary, in contrast to the montane meadows (between 550–2100 m) of the mountain ranges inhabited by the even more widely distributed *C. perfusana*, from the Carpathians and the Pirin Mountains through the Austrian Alps and Switzerland to the Hautes Alpes in France.

Discussion

Small unintended erroneous statements can lead to subsequent longstanding taxonomic errors. Such taxonomic or nomenclatural problems spanning generations are not rare, indeed frequent for Cochylini. One problem regarding *Longicornutia epilina* (Duponchel, 1842) has already been discussed by Kovács and Kovács (2020: 7).

The case of the *Cochylimorpha perfusana* species group is also problematic. Treating two related species in two different volumes, *Cochylis perfusana* in the fourth volume of his Systematische Bearbeitung der Schmetterlinge von Europa (Herrich-Schäffer 1851: 183) and *C. callosana* in the sixth volume (Herrich-Schäffer 1856: 157), but in the index giving for both the same cross-reference, that referring to *perfusana*, Herrich-Schäffer (1856: Index 7, 32) created a misleading situation. This confusing statement was probably the starting-point which led to the subsequent confusion of the two taxa, to the incorrect reference of the description of *C. callosana*, to its wrong type locality and also to the subsequent synonymy of three related taxa (Razowski 1970: 38–39, 162). The latter act, the consequence of the original mistake, has resulted in an incorrect species concept, which had been accepted for more than 50 years.

Guided by the data in Razowski (1970: 162) referring to the depository institution of the “holotype” of *Argyrolepis perfusana* Guenée, 1845, the specimen labelled as “Type Guenée” has been located in the NHMUK, and the photograph of the adult examined through the courtesy of D.C. Lees, R.J. Heckford and S.D. Beavan. The fact that the species was described based on an unspecified number of specimens, and a large distribution area given as “In summis montibus Austriae et in alpebus Delphinatus” (Guenée 1845: 302), suggests that the description was not based on a single specimen. As a consequence, the type material might consist of a number of syntypes. However, in the NHMUK there are no other historic specimens that support this hypothesis (D.C. Lees pers. comm.). Further studies may clarify this possibility and identify the putative syntypes. For the time being, in accordance with the ICZN article 74.6, Razowski’s (1970: 162) treatment of the type specimen as the holotype must, instead, be considered a lectotype designation.

Razowski (1970: 162) and in his subsequent works (Razowski 2002: 43; 2009: 37) erroneously cites “HERRICH-SCHÄFFER, 1851, Syst. Bearb. Schmet. Eur. 4: 183” for the description of *callosana*, also the type locality is incorrectly specified as “Niederösterreich: Schneeberg”. These data in fact refer to *C. perfusana*. The correct year of Herrich-Schäffer’s description of *callosana* is 1856, the volume 6, the page 157 and the type locality Fiume (= Rijeka) in Croatia.

DNA sequencing has an important role in the taxonomy of the 21st century. DNA barcoding, in particular, has become the most important tool in uncovering unjustified synonymy and cryptic diversity. Several cases were previously remedied within Lepidoptera including a few in the European Cochylini (Mutanen *et al.* 2012; Zlatkov and Huemer 2017; Corley and Ferreira 2020; Kovács *et al.* 2020). The *C. perfusana* species group is now a further example. Molecular studies can also reveal the relationships among the taxa of such species groups, which in this case fully supports the close relationship of the four species that form the informal *C. perfusana* species group. At the

time of their descriptions, the authors considered them closely related based only on the similar external morphology. The diversity within the group was questioned during the study of the genitalia which, being very similar especially in the males, led to the synonymy of the earlier known three taxa. Finally, owing to the molecular studies, we were able to reinstate all of the previously named taxa to their original specific rank and to discover and describe one more cryptic species in this species group. Furthermore, the availability now of DNA barcodes for all four species of the *C. perfusana* species group makes possible COI based identification. *Cochylimorpha dorsimaculana* shares a BIN with *C. perfusana*, but clusters separately as its sister group with a minimum distance of 1.07%, whilst the minimum distances to the other two species exceed 3%. However, the strikingly different external morphology and the differences in the genitalia structure of both sexes compared to all of the other three species necessitated its treatment as a separate species. The small minimum inter-specific distance indicates that phylogenetically it is the most recently evolved member of the group.

Similarity in the genitalia of closely related species seems to characterize Cochylini. This is already the fourth species group of related taxa earlier synonymized mainly following the study of the genitalia and recently taken out of synonymy after their DNA sequencing. In three of them, the species pairs *Phalonidia manniana* (Fischer von Röslerstamm, 1839)/*P. udana* (Guenée, 1845) (Mutanen et al. 2012) and *Cochylimorpha discopunctana* (Eversmann, 1844)/*C. punctiferana* (Ragonot, 1881) (Corley and Ferreira 2020), and the *C. perfusana* species group studied here, the careful re-examination of the external morphology and the genitalia allowed the clear differentiation of the taxa. However, in the fourth grouping, the *Phtheochroa frigidana* (Guenée, 1845) species group (Zlatkov and Huemer 2017; Kovács et al. 2020), the use of special techniques, i.e., in the male, the eversion and study of the three-dimensional structure of the vesica, was necessary to reveal the differences in the otherwise similar male genitalia, and in the female, the discovery of a previously ignored membranous structure of ductus bursae, the ventral diverticulum, together with other small differences, allowed the morphological differentiation of the taxa.

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Appendix 1

Table A1. Details of Sample ID, Process ID and GenBank Accession for 10 BIN-conforming sequences used for the tree in this paper.

Species	Sample ID	Process ID	GenBank Accession	BIN URI
<i>Cochylimorpha perfusana</i>	TLMF Lep 28732	DEPAL247-20	PP495388	BOLD:ADI4764
<i>Cochylimorpha perfusana</i>	BC_LSNOE_Lep_02140	NOELE477-20	PP495396	BOLD:ADI4764
<i>Cochylimorpha callosana</i>	TLMF_Lep_32487	DEPAL854-23	PP495393	BOLD:ADI3050
<i>Cochylimorpha callosana</i>	Junnilainen_46193_H04	DEPAL943-23	PP495395	BOLD:ADI3050
<i>Cochylimorpha dorsimaculana</i>	BC_LSNOE_Lep_02046	NOELE383-20	PP495390	BOLD:ADI4764
<i>Cochylimorpha dorsimaculana</i>	BC_LSNOE_Lep_02048	NOELE385-20	PP495389	BOLD:ADI4764
<i>Cochylimorpha bucegiana</i>	TLMF Lep 28734	DEPAL249-20	PP495387	BOLD:AEH6249
<i>Cochylimorpha bucegiana</i>	TLMF Lep 28750	DEPAL265-20	PP495391	BOLD:AEH6249
<i>Cochylimorpha jucundana</i>	TLMF_Lep_32425	DEPAL792-23	PP495394	BOLD:AAY8848
<i>Cochylimorpha jucundana</i>	TLMF_Lep_32427	DEPAL794-23	PP495392	BOLD:AAY8848